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FOR ENGINEERS AND CONTRACTORS CONTROLLING THE DESIGN, SPECIFICATION, INSTALLATION AND MAINTENANCE OF HEATING, VENTILATING AND AIR CONDITIONING.

HEATING & VENTILATING

AIR CONDITIONING

FOR APRIL, 1939

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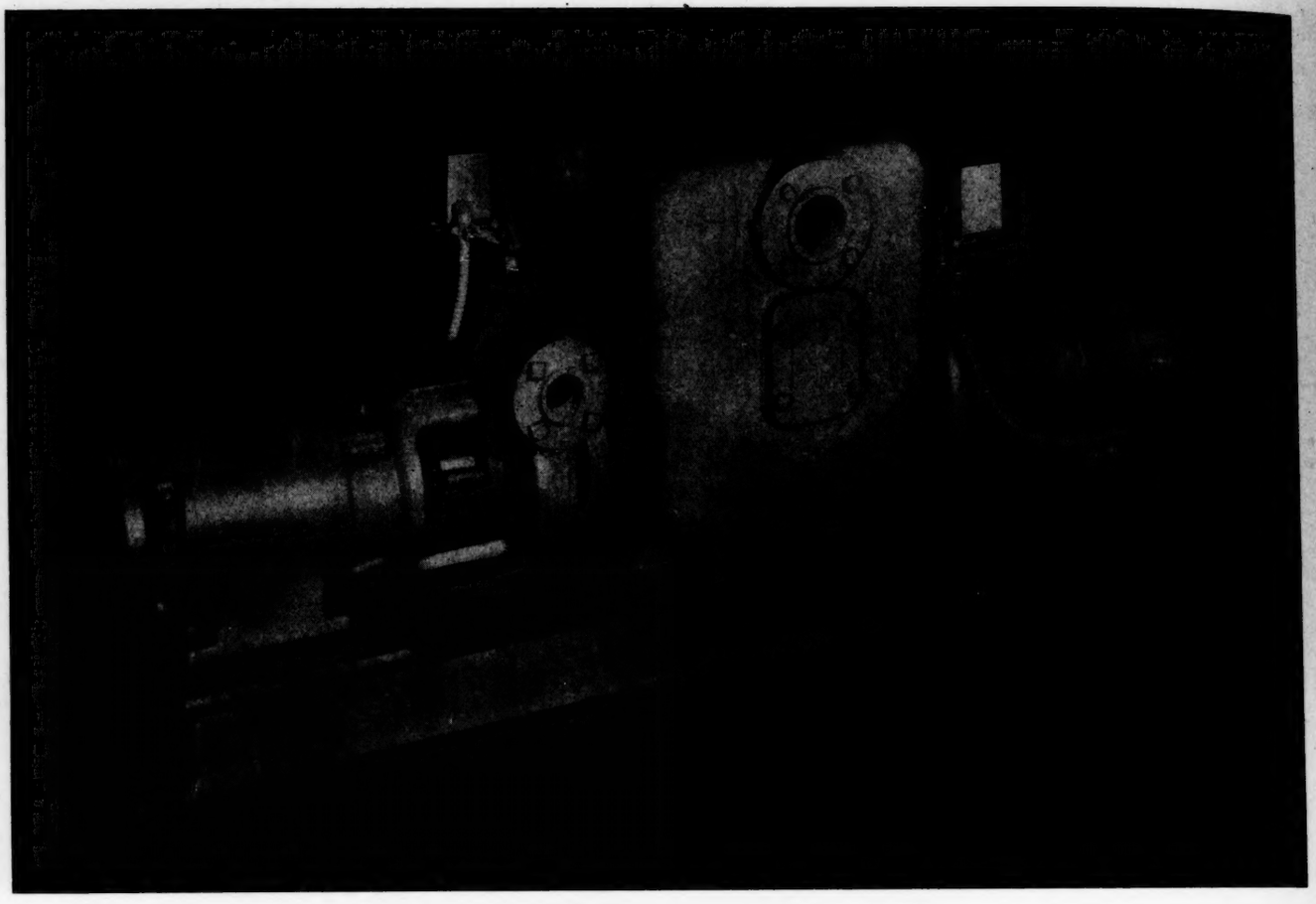
MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



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Full automatic control is furnished by means of a ball float and float switch mechanism mounted on the receiving tank. All wiring is made up at the factory, and it is necessary only to connect the pump to the system and hook up the leads. Complete information regarding these economical pumps sent promptly on request.

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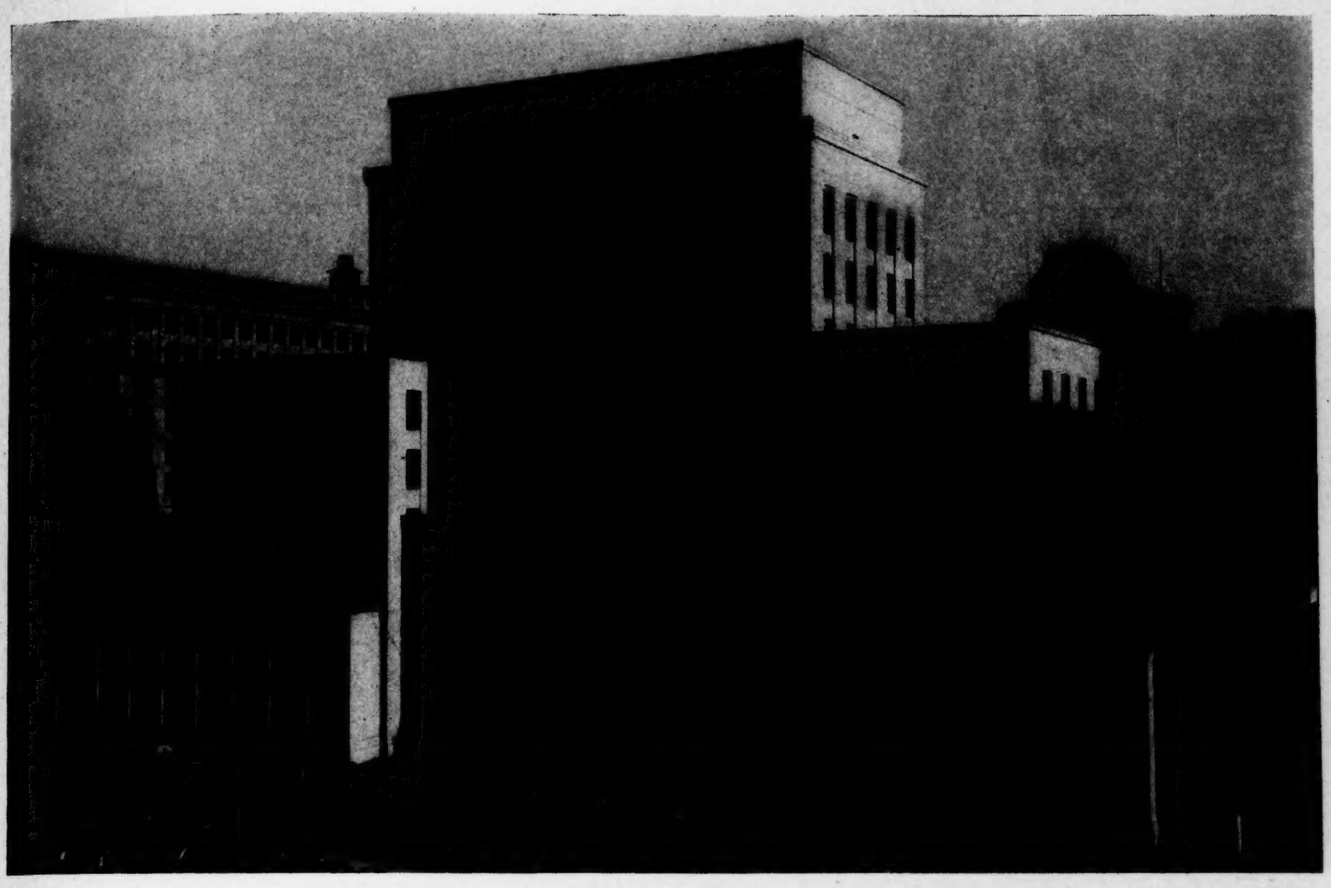


Fig. 1. Exterior of the new Liberty Mutual Insurance Building, Boston.

Large Office Heated and Ventilated by Zoned Split System

By FRANK A. MERRILL†

BECAUSE of the flexibility in control, better possibility of continuous uninterrupted service, low steam consumption, minimum of maintenance and maximum obtainable control for comfort, the split system of heating and ventilating was chosen for the new home office building of the Liberty Mutual Insurance Company in Boston. This building was designed to function in the latest and most efficient manner not only because of its unique planning features but also its mechanical equipment.

The building occupies an entire corner block in uptown Boston and is 10 floors high, containing 3,100,000 gross cu. ft. The gross area, including the basement, is 206,612 sq. ft. The building is strictly utilitarian, the first eight floors being office working spaces with executive offices on the ninth floor. The mechanical equipment is installed in the sub-basement and on the tenth floor. Steam for heating, ventilating, and service hot water is purchased from the Boston Edison Company. The total quantity of steam supplied to the building is measured by a flow meter and separate condensate meters measure the steam consumed for heating and service hot water.

†Consulting Engineer, Office of Hollis French.

The Heating System

Heating is by a two-pipe atmospheric steam system with all condensate gravitating to an open receiver and then pumped through service hot water economizers to the sewer. Steam distribution is zoned in accordance with the most modern principles of design. The location of the structure with respect to the points of the compass permitted the use of the minimum number of exposure zones, one for each of the four sides of the building. On the first eight floors cast iron finned convectors, located under windows, furnish the necessary heat required to compensate for the transmission losses through the exterior walls. Each convector is entirely concealed in steel enclosure, the top of which forms the sill of the window. Slots are provided at the floor and grilles in the sill for the circulation of air. The steam inlet to each convector is equipped with a fixed orifice and a union elbow is installed on the return connection. No traps are provided on these heating elements

thus eliminating any possible cost of repair and maintenance due to their presence.

Heat is supplied to the ninth floor through air conditioning cabinets installed under the windows. The heating elements in these cabinets are connected to the same zones that supply the convectors on the floors below, but no orifices are provided. Each element is equipped with an automatically controlled modulating valve on the supply connection and a float and thermostatic trap on the return. Individual room thermostats regulate the temperature in each office.

The main entrance lobby, which faces west, is subjected to wide demands for heat owing to the frequent opening and closing of three vestibule doors admitting large quantities of outside air. The lobby is divided by two passageways, one on each side of the central information desk. Heat is supplied to both lobby and vestibule by means of two hot blast units located in the basement.

Steam is supplied to the building at approximately 100 lb. pressure from the street system and is reduced to 40 lb. pressure. At the latter pressure it is conveyed to a central location in the apparatus room, at which point it is reduced to 8 lb. for the heating system and 10 lb. for indirect stacks of the ventilating system. A 40-lb. connection is provided for heating service hot water. Steam for heating the building is discharged from the reducing valves at 8 lb. pressure to a distributing header, from which it passes through separate mains to the various zones. A 20-point modulating pressure controlled compensating valve and pressure box is installed in each of the mains of the four exposure zones. The valves regulate the flow of steam at pressures varying from 4 oz. to 48 oz., so that the desired degree of modulation may be obtained. By the aid of the precision orifice each convector thus receives not only an equal or evenly distributed portion of the steam supplied in accordance with the size of the element but is also furnished with a metered quantity of heat that gives the correct number of B.t.u. to just balance the required B.t.u. log of the building.

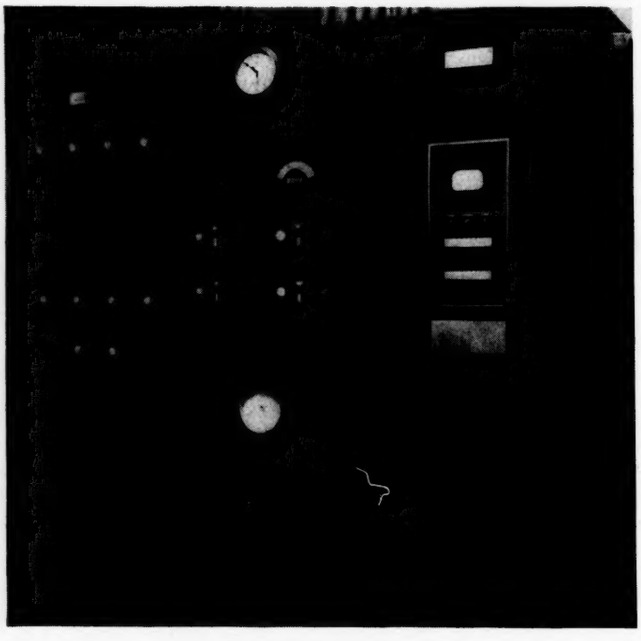


Fig. 2. Central control board.

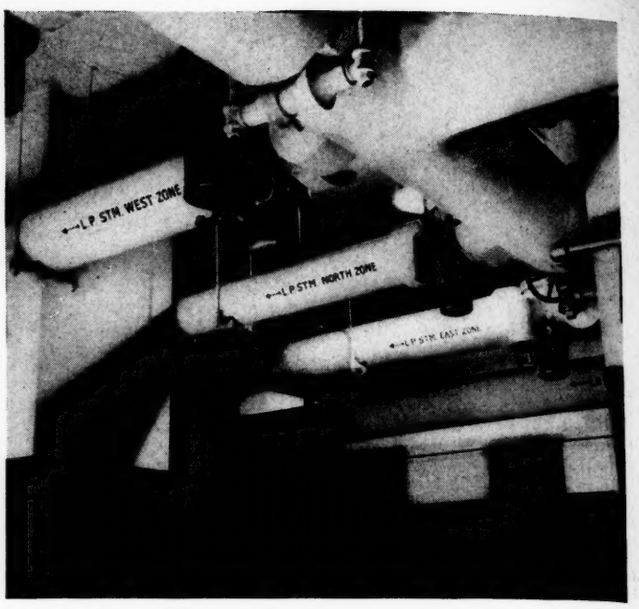


Fig. 3. Zone control mains leaving header in apparatus room.

Zone Controls

Control of each exposure zone is accomplished by an electrically operated compensator erected in the building wall. These controls are so sensitive that change in sunshine, out-of-door temperature or wind velocity or direction immediately alters the amount of steam flowing to the convectors in the exposure zone affected.

The two hot blast zones for heating the lobby are similarly controlled by pressure modulation but the actuating instruments employed are super-sensitive modulating indoor thermostats mounted on the side of each passageway from the front lobby leading into the elevator corridor. The action of these thermostats is to increase the supply of steam to the unit coils when the doors are opened in order that the personnel at the information desk within twenty feet of the entrance doors will be unaffected by cold drafts due to the large number of persons entering and leaving the building during rush hours. To further reduce the influx of cold air into the lobby, heated air is forced into both ends of the main vestibule and is controlled by separate thermostats installed between the inner and outer doors. These controls also prevent the excessive rise in temperature within the vestibule when there is little or no passing in and out of the building.

Central Control Panel

All the steam regulating equipment, with the exception of the controls on the ninth floor, is wired to a central control panel located in the sub-basement apparatus room so that the system may be operated at any time under either remote manual or automatic control, as desired. The control board consists of a three-panel steel cabinet on the face of which is mounted separate zone selector switches for either automatic or manual operation; pushbuttons for increasing or de-

creasing steam flow to each zone, together with devices to indicate the quantity of steam being supplied to each zone. Red and green pilot lights are provided so that the operator may determine at a glance whether the system is operating under either automatic or manual control. Flashing lights indicate the opening and closing of the zone valves.

To assist the operator in checking the performance of the system under automatic control and to facilitate the setting of steam flow devices under manual operation, outside temperature recorder, wind direction and wind velocity indicators are provided. Constant check on entire inside conditions is maintained by remote temperature indication.

One of the marked advantages of the zone control split system lies in the ability to supply small quantities of steam for heating only to a section of the building at unusual hours without requiring the maintenance of the entire building at higher temperatures or providing unnecessary ventilation. This flexibility has been very effectively demonstrated in this installation.

The Ventilating System

To avoid architectural and structural changes in the future the basic design of the system involves complete air conditioning for the entire building. At present, however, only winter conditioning and summer ventilation are provided.

For air distribution the building is divided at its center line into two wings, north and south, extending from the first to the ninth floors. In each wing four separate air conditioning zones are established, one for each exposure and one for the interior section of the building. By the employment of interior zones low temperatures, essential to offset the heat generated by the occupants and lights, can be maintained within these areas at the same time that high temperatures prevail in the exposure zones around the perimeter of the building. During the summer converse conditions may be attained. In view of the shifting solar radiation the advantage in having separate exposure zones is obvious.

Conditioned air is supplied to the eight zones through duct risers erected in two centrally located shafts (one for each wing) extending from central station apparatus in the sub-basement to the 10th floor. Horizontal distributing ductwork installed within furred ceilings conveys the air from the duct risers in the shafts to the various zones. With the exception of the ninth floor every square foot of working floor area receives its proportionate amount of conditioned air through outlets located on the face of false beams. The furred ceilings

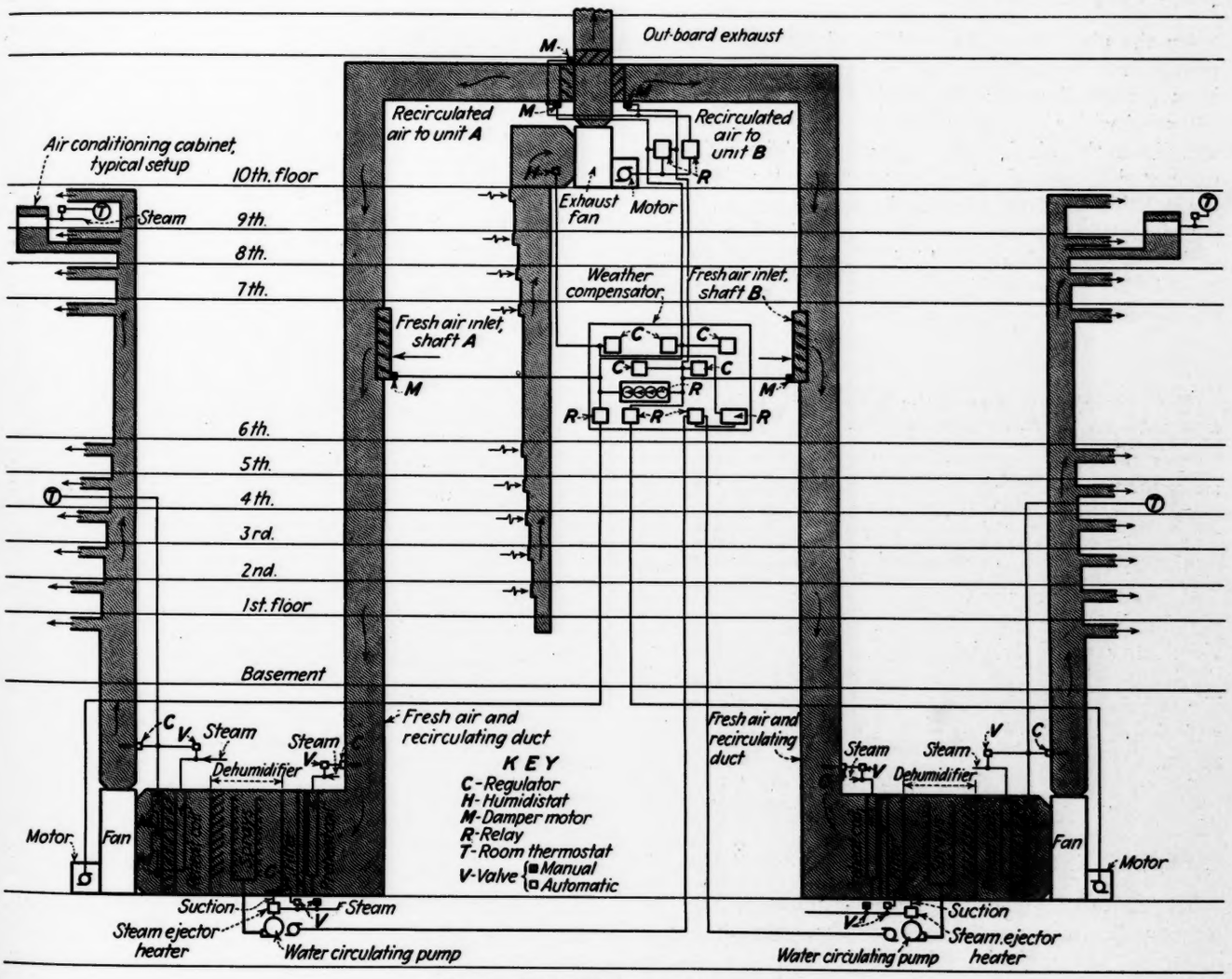


Fig. 4. Ventilating control diagram.

between the beams are constructed of metal acoustic tiles which can be easily removed for access to deflectors in ducts. The system of air distribution is designed so that at any future time the large open areas may be divided into private offices without necessitating changes in the ceiling construction to accommodate air ducts or outlets. This feature is of prime importance considering the departmental changes which naturally are anticipated. The air outlets are equipped with both horizontal and vertical deflectors designed for proper throw, maximum inductance, and quietness of operation.

In general, the return air, common to all zones, is removed through grilles located at the floor near the center of the building and adjacent to the trunk shafts. This air is drawn upward in the space around the supply ducts in the shafts by exhaust fans installed on the tenth floor. Part of the return air is discharged outboard and the remainder is forced downward through four separate shafts to the conditioning apparatus in the sub-basement, depending upon the quantity of fresh air being introduced. Fresh air is admitted to these four air shafts through intakes located at the sixth floor so that above this level the shafts serve as recirculating ducts and below they convey a mixture of fresh and recirculated air.

Ninth Floor Details

On the ninth floor the conditioned air is discharged through combination heating and air conditioning cabinets concealed under the windows. Each cabinet is equipped with air nozzle and supplementary heater designed on the air induction principle. The units are connected to the air distribution zones for the lower floors. Booster fans designed to increase the static pressure at the nozzles will be installed when cooling and dehumidification are added. The volume of air supplied by each cabinet is controlled manually, subject to the requirements of the occupants.

Central Air Apparatus

The central station conditioning apparatus is divided into four groups or units. Each unit consists of finned copper tube preheater, self-cleaning oil type air filter, all copper double spray conditioner, finned copper tube reheater, mixing and bypass dampers, and supply fan. The apparatus in each group has a capacity of 40,000 c.f.m. of air, or a total of 160,000 c.f.m. of air circulated.

When cooling equipment is installed a separate supply fan, reheater and mixing dampers are to be provided for each of the eight zones. At present for ventilating services, only four supply fans are required. Two of these fans furnish air to the six exterior zones and the other two fans supply air to the two interior zones.

Separate units provide ventilation of the basement, toilets, and locker rooms.

Control of Air System

The entire ventilating system operates under full automatic electric control. The diagram shown in Fig. 4 illustrates the method used in controlling the central station apparatus. One of the outstanding features of

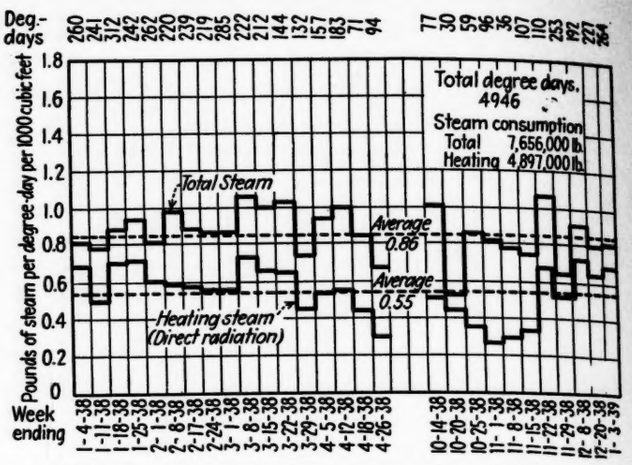


Fig. 5. Record of steam consumption, 1938-9.

the control system is the method utilized in modulating the fresh air admitted to the building. Each central station unit is equipped with fresh air damper actuated by a wide differential controller so adjusted that it will take in 100% fresh air at 60F and 30% fresh air at 0F and vary between these points in accordance with outside conditions. As the outside temperature rises above 70F, the fresh air is reduced gradually to 25% at 95F. Indicating dials show the percentages of fresh air supplied by positions of the damper. An automatic damper is placed in the outboard and in the recirculating duct on the discharge side of the exhaust fan. These dampers are equipped with automatic controls designed to synchronize their operation so that when the fresh air damper is 100% open, the exhaust damper is fully open and the recirculating damper closed. As the percentage of fresh air varies, the percentage of exhaust and recirculation also varies in the same proportion.

Each conditioner is under the control of a dewpoint thermostat designed to operate three-way valve in cold water supply to tank and automatic steam valve to ejector water heater. In the return air from the zones high limit thermostats under the control of outside compensating instruments start and stop the spray pumps to maintain proper humidity conditions.

To obtain the necessary balance between the heating system and the ventilating system, and thus maintain constant comfort conditions, averaging thermostats are installed in each conditioned zone designed to raise or lower the entering temperature of the air and consequently prevent overheating or underheating resulting from variations in the operation of the zone-controlled heating system. Remote temperature indicating stations are provided in all zones and wet and dry bulb remote indicating elements are installed in the main air ducts leaving the central station units. By pressing buttons on the main control panel the operator can check at any time the temperature in all parts of the building as well as the temperature of the air being supplied. This method enables him to adjust the steam flow to the heating zones manually at any time to maintain proper relation between the heat emitted from the convectors and the heat delivered by the ventilating air. Cellular type sound absorbers in air ducts, rubber-in-shear equipment mountings, and specially designed motors insure quiet operation.

The first full year's operation of the system has shown an unusually low steam consumption. It is to be noted from the chart, Fig. 5, that the average total steam consumption for heating and ventilating was 0.86 lb. per degree-day per 1000 cu. ft. of treated space. For heating only, the steam consumption averaged 0.55 lb. per degree-day per 1000 cu. ft. of heated space, a truly exceptional performance.

The architect was Chester Lindsay Churchill, who designed and planned the building, including the structural engineering and correlation of the mechanical engineering, and was in direct charge of the entire project to its completion. The office of Hollis French was the consulting engineer. Turner Construction Company was the general contractor, M. J. Flaherty Company installed the heating work, and Carrier installed the ventilating equipment. R. A. Russell is the engineer in charge of operation at the building.

Air Conditioning Justified by Elimination of Employe Fatigue

WITH a complete heating and cooling season now behind them, officials of the Commercial Travelers Mutual Accident Association of America report that the usual afternoon fatigue experienced by employes in their building at Utica, N. Y., has practically been eliminated.

"From that one item alone we feel that our year-round air conditioning system has justified itself," declares Edward Trevett, assistant secretary-treasurer. The company has insufficient data at present to draw any broad conclusions regarding the effect on employe health, but says that the system has satisfactorily met not only the cooling load of summer but has given adequate warmed and conditioned air in winter.

Because of the characteristics of the building, and the changing solar and wind effects on various parts of it, the system was zoned carefully to maintain even temperatures throughout winter and summer. The building was divided into five separate year-round conditioning zones and one straight winter conditioning zone, with direct radiation used at such points as entries and lavatories.

In order to save floor space and simplify the plan generally, all equipment was located in the basement. To furnish steam seven oil boilers were placed in one of the old boiler rooms. A 5000-gal. oil tank was located in one of the old coal bunkers and a new concrete slab poured over it, so that no excavation was required. A 40-hp. compressor and two-speed 50-hp. compressor were placed in an old storage space in the basement on suitable foundations, as were the 7½-hp. cooling tower pump and condenser water pump. A cooling tower was placed on the roof atop the elevator penthouse to insure good circulation.

Zone 1—the largest and having the greatest exposure—consists of the entire one- and two-story extension at the rear of the building exposed on three sides and with roof above. All conditioning for this zone was supplied from a single unit with a total air flow of 14,000 c.f.m. Refrigerating effect is produced by a 40-hp. compressor while steam for the heating coils is supplied through a modulating valve on the main steam supply line from the boiler room.

Zone 2—the first floor of both old and new buildings at the front—consists of reception room, private offices, and vault. The latter presented a difficult problem because no openings were permitted into the vault through which ducts could be run. The vault consists of two floors, the first one in the basement. In order to circulate conditioned air through it, air was discharged in a closed hallway into which the basement vault door opens. A brick duct was constructed at the rear corner of the vault, with two openings in the basement room, and an opening at the ceiling of the second floor room to accommodate a 12-in. fan. With this arrangement, and the vault doors left open during working hours, it was possible to circulate conditioned air through the basement vault, up the duct into the room above, and out into Zone 2 space. Because of the small load involved, a small conditioner was used, with fans mounted on the inside and driven by a 1-hp. motor. For economy reasons, this zone is connected to city water supply instead of to the main cooling tower.

Zones 3 and 4 consist of the front and rear portions, respectively, of the second, third, and fourth floors, and they have almost identical control and equipment. These areas were so grouped because they have identical losses and exposures. Conditioned air is supplied to each floor in these zones through a central trunk duct passing up through the center of the building. Conditioners are similar to those used elsewhere in the building, but refrigeration is supplied by a two-speed, 50-hp. condensing unit serving zones 3, 4, and 5.

The entire fifth floor of the building constitutes Zone 5, and has exposure on all four sides with skylights in the roof above. The conditioning equipment is the same as in zones 3 and 4 except that booster heating coils are installed in the two branch ducts leading to the east and west sides of the building, allowing separate temperature control during the winter for an area which might otherwise be out of balance because of wind conditions.

Each zone is equipped with a modutrol thermostat, compensating thermostat and humidistat. In addition the whole system is controlled by an outside-inside temperature compensator, which allows the inside temperature to vary from 72 to 80F, while the outside varies from 72 to 95F.

Equipment, Well Water, Body Temperatures Discussed at Air Conditioning Conference

A broad range of highly interesting subjects was covered in the 1939 Conference on Air Conditioning at the University of Illinois last month. The accompanying report is presented through the cooperation of Professors W. H. Severns and P. E. Mohn of the University's staff.

TWO hundred and seventy-five dealers, contractors, and prospective owners of comfort air conditioning equipment attended the sessions of the 1939 Conference on air Conditioning, held at the University of Illinois, March 8-9. The scope of the conference, which was sponsored by the department of mechanical engineering and the Engineering Experiment Station, was all-year comfort air conditioning with its problems and new developments.

The highlight of the conference was the dinner, March 8, attended by more than 175. Dr. A. C. Willard, president of the University of Illinois, served as chairman, and presented the speaker of the evening, Dr. Charles Sheard, director of the Division of Physics and Biophysical Research, The Mayo Foundation and the Mayo Clinic. Doctor Sheard spoke on Physiological Responses of the Body to Its Environment. Relating numerous research results in varying body temperatures, Doctor Sheard explained that forehead temperatures are rather constant—thus making fever detection easy—but that the fingers and toes vary a great deal and are more sensitive indicators of recurring changes in the body.

Control of these experiments is difficult, he declared, because of the human element. "Only one fellow controls me, and that is myself," he said. Common sense cannot be used in the experiments because "there is no such animal."

"Shivering is producing heat; a red face indicates the same thing, and sweating is the last stage of passing off heat," he said. Heat production and release must be equalized to maintain a constant temperature of 98.6F.

"Relative humidity ordinarily plays little part in comfort. A change of one or two degrees in temperature is equal to 30 or 40% change in humidity," he asserted.

This does not mean, however, that the statement "it's not the heat; it's the humidity" is not true. "On a hot day when the relative humidity is high, you just can't sweat and cool the skin," he explained.

Common colds, influenza, and pneumonia are prevalent in the spring and fall, Doctor Sheard pointed out, and are caused by the change, the "sweating it out," and the cooling. Too much food and smoking, too many cocktails, and too little exercise contribute also. Air conditioning in homes in summer is desirable because it lowers the temperature and permits restful sleep.

Dean M. L. Enger of the University's College of Engineering, presided at the opening session, giving an address of welcome and commenting upon the teaching and research in heating and air conditioning at the University.

Equipment for All-Year Air Conditioning was discussed by Professors Severns and Mohn. In addition to the usual air conditioning equipment the paper covered all-year air conditioning equipment employing absorption refrigeration, commercial all-year air conditioning units operating on the reversed refrigeration cycle, chemical systems for all-year air conditioning, air cleaning by electrical precipitation, and the absorption of odors from recirculated air.

S. H. Downs, chief engineer of the Clarage Fan Company, was the third speaker of the first session and dealt with the Characteristics of Duct Systems and Fans. Mr. Downs gave an interesting presentation relative to the characteristics of duct systems, the effects on fan performance produced by different shapes of fan blades, fan laws, and the sources of noise in air conditioning ductwork.

Mr. Downs acted as chairman at the second session, March 8. Prof. D. W. Nelson of the University of Wisconsin spoke first at the second session on the subject of Introduction and Diffusion of Conditioned Air in Rooms. Professor Nelson's paper dealt with problems of air distribution, motion, register locations, and noise difficulties. Plain openings versus air inlets and outlets fitted with grilles were compared and the effects of various types of grilles and the influence of their design on air velocity, distribution and the effective throw from them were shown.

Speaking on the subject of Regulation of Air Temperature and Humidity, C. L. Ringquist, of The Trane Company, pointed out the necessity of adequate controls in air conditioning systems. Topics of the talk included controls for air washers, heating and cooling coils, chemical dehumidification of air, the reheat cycle, the bypass method, split-coil systems, precooling and reheat cycles, split systems and zoned systems.

S. I. Rottmayer acted as chairman of the morning session, March 9. In a paper dealing with Refrigerating Problems in Comfort Air Conditioning, R. E. Gould,

At the speakers' table, Air Conditioning Conference, left to right: Dean M. L. Enger, Mrs. O. A. Leutwiler, Dr. Charles Sheard, President A. C. Willard, Mrs. Charles Sheard.

assistant manager of air conditioning engineering, Frigidaire Division, General Motors Corporation, spoke of problems in refrigeration arising in air conditioning plants, the effects of climatic conditions, sources of heat gains and proper air temperature conditions.

Building Insulation, Types and Applications was the subject of a talk by Prof. S. Konzo, of the University's department of mechanical engineering. His paper included material relative to the various kinds of building insulation now available and its placement in building walls, floors, ceilings, and roofs. Insulated walls were divided into general classes, i.e., according to their overall coefficients of heat transmission, U, with the insulation in place. He classified those having a heat transmission coefficient, in B.t.u. per hr. per sq. ft. per deg. F, of 0.1 or less, as excellent; 0.1 to 0.2, good; 0.2 to 0.3, fair; and over 0.3, poor. Professor Konzo pointed out the desirability of placing insulation in ceilings below attic spaces rather than applying the insulation to the roof rafters above attics.

The third paper of the Thursday morning session was given by L. V. Teesdale, senior engineer, Forest Products Laboratory, on Condensation Problems in Modern Buildings.[1]

Prof. O. A. Leutwiler, head of the department of mechanical engineering, University of Illinois, presided at the final session Thursday afternoon, March 9. At this session W. D. Gerber, engineer, Illinois State Water Survey, gave information relative to Illinois water supplies, quantities and temperatures and disposal methods in connection with air conditioning plants in his paper Air Conditioning Water Supply and Disposal. Where air cooling and dehumidification are necessary, Mr. Gerber pointed out that the initial temperature of the water used for such purposes in coolers and dehumidifiers should be at a temperature of 55F or less. Surface waters are usually above 55F as is also the case from extremely deep wells. Water from wells not exceeding 400 ft. in depth generally is attractive from the standpoint of temperature. Certain areas in the states of Illinois and Wisconsin are better favored than others with the possibilities of water supplies from wells, but even in such areas wells should not be located indiscriminately. Mention was made of the rock, sand, and gravel formations in which desirable water supplies may be obtained.

S. I. Rottmayer, mechanical engineer, S. R. Lewis, Chicago, gave the concluding paper, Conservation of Water by Using Cooling Towers and Evaporative Condensers. Types of cooling towers and their designs and materials of construction were included. The construction and performances of evaporative condensers were pointed out and calculations were given as examples of the estimation of cooling water requirements.

The general committee in charge of the conference consisted of Professors Severns, Mohn, and M. K. Fahnestock. Registration records indicate that the Conference drew attendance from 11 states and the District of Columbia. All sessions were enlivened by considerable discussion of the papers presented, thus making the Conference of greater value. Organized tours at the close of each afternoon session were conducted to an air conditioning plant in the Lincoln Hall Theater on the University campus, and also to the Research Residence and Mechanical Engineering Laboratory.

[1]This paper is abstracted on page 36 of this issue.

Degree-Days in the British Isles

THE ordinary degree-day as used in the United States and having a base of 65F would probably not be applicable to buildings where the inside temperature is maintained sharply below 70F. In Great Britain, for example, where inside temperatures are very frequently maintained at a lower point than they are in this country, it is probable that the base would be something lower than 65F.

Writing in a recent issue of *Heating & Ventilating Engineer* (Great Britain), Harold Swaine has used 60F as the base for degree-days in the British Isles. He has tabulated the normal degree-days on the basis of 60F for a number of English, Scotch, Welsh, and Irish cities and from his data the table is tabulated.

NORMAL NUMBER OF DEGREE-DAYS (60F BASE) FOR BRITISH CITIES (OCTOBER TO MAY, INCL.)

City	Degree-Days
England	
Ascot	3840
Bath	3560
Bellingham	4845
Bexhill	3500
Birmingham	3920
Blackpool	3805
Bradford	4170
Brighton	3415
Cambridge	3810
Cheltenham	3670
Coventry	3818
Croydon	3520
Dover	3550
Hastings	3461
Huddersfield	4265
Hull	3885
Lancaster	3890
Liverpool	3730
London	3590
Lowestoft	3815
Luton	4010
Macclesfield	4200
Manchester	3720
Mansfield	4075
Newport, (Mon.)	3560
Norwich	3740
Nottingham	3905
Oxford	3676
Plymouth	3135
Portsmouth	3245
Reading	3835
Scarborough	3250
Sheffield	3865
Southampton	3410
Tunbridge Wells	3820
Tynemouth	4370
Worcester	3836
York	3855
Scotland	
Aberdeen	4250
Balmoral	5102
Dundee	4300
Edinburgh	4210
Glasgow	3970
Greenock	4035
Ireland	
Cork	3425
Dublin	3380
Waterford	3444
Wales	
Cardiff	3650
Rhyl	3580
Welshpool	3905

Sanitary Ventilation in Wards

By WILLIAM F. WELLS†

The study reported in this article is supported by a grant from the Commonwealth Fund to the University of Pennsylvania for investigations on air-borne infection with laboratories in the Department of Bacteriology, the Children's Hospital, and the Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis.

OUR changing attitudes toward the role of air in the spread of infection is one of the anomalies of public health. Before the germ theory postulated the communicability of infectious diseases, they were generally presumed to be spread by atmospheric miasmas. Where direct contact between one case and another could not be demonstrated, vehicles of spread were assumed, and the discovery of these vehicles, with the consequent control by engineering means constitutes a brilliant chapter in public health.

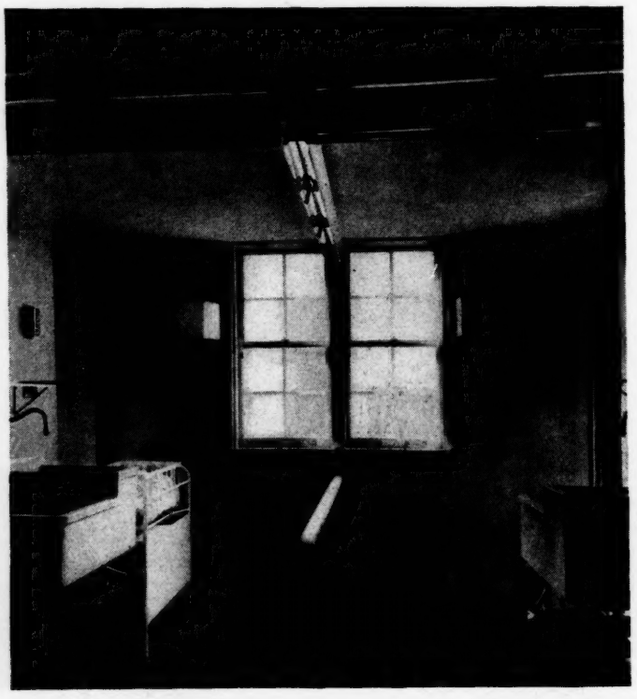
The spread of respiratory infection among aggregations breathing a common air supply did not seem to require a vehicle of spread because obvious opportunities for personal contact existed. Efforts to control these diseases by preventing "contact" and by preventing the direct spray of droplets from the nose and throat of one person to those of another have not proved markedly successful. Even in hospital wards, where control of the "hand-borne" germ has become a highly technical ritual, and where cubicle partitions prevent the spread of infection by direct spray, the spread from patient to patient of such diseases as measles, chickenpox or the common cold remains a serious problem.

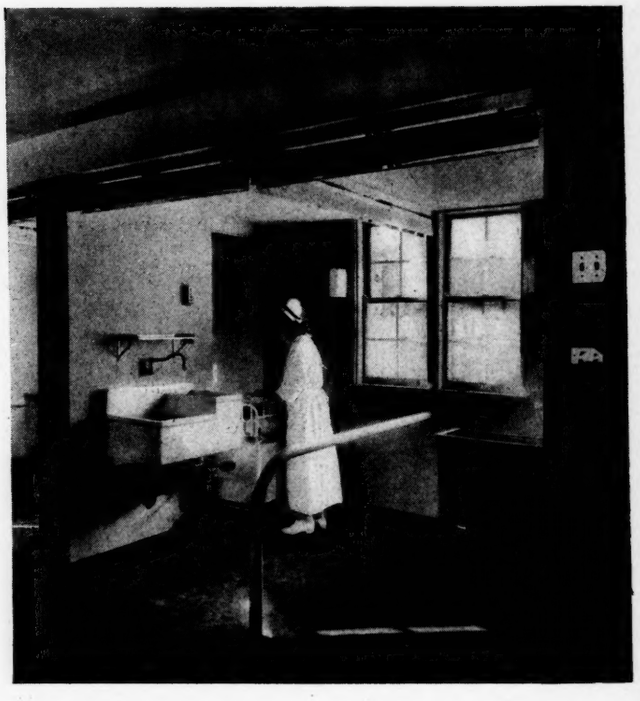
Recent bacteriologic studies have indicated that the small droplets from the nose and mouth spray evaporate and are borne by the air of our enclosed habitations during the winter months, becoming an important factor in the spread of respiratory parasites. Epidemiological data corroborating these bacteriological findings are also accumulating. The problem of preventing the spread of contagion by air thus becomes a challenge to the ventilating engineer just as, half a century ago, the prevention of water-borne infection became the problem of the designer of municipal water supplies.

The first building in which sanitary ventilation has been incorporated in the design has just been erected by the Cradle Society in Evanston, Ill., and dedicated to the prevention of spread of respiratory infection among new-borne infants. It is especially fitting that this test of the prevention of the spread of infection by air should be made at this institution, for the Cradle technique for the prevention of transfer of contact infection has found wide adoption by other hospitals.

The new Cradle building is divided into three units, each designed to test the efficacy of one modern method of preventing air-borne infection, each method being based upon a different principle. In one unit, the attempt is made to eliminate, by rapid air change, microorganisms added to the air by the occupants of the unit. In the second unit, this principle of isolation is carried further by isolating the infants in separate air conditioned cubicles, even the nurse being excluded. The third unit is shown in the photographs. Here the at-

†Laboratories for the Study of Air-borne Infection, University of Pennsylvania, Philadelphia.





Cubicles designed for the Cradle Society, at Evanston, Ill., to establish ultra violet light barriers to prevent cross-infection.

tempt is made to establish an ultra-violet light barrier between the children, thus extending the barrier principle first applied by Dr. Charles F. McKhann in a corridor of the Isolation Unit of the Infants' and Children's Hospital, Boston.

Curtains of ultra-violet light are dropped between the cubicles, continuous with a ceiling of bactericidal light emitted from the same source. These walls or curtains are so designed that the eyes of the nurse are not brought into range of the overhead lights, and the time to which the nurse is exposed to ultra-violet light in walking through the wall is so brief as to involve no chance of sunburn. However, the walls are relatively impenetrable to the passage of bacteria borne on ventilating currents and have been demonstrated to be especially effective against the type of infection produced by the evaporation of droplets coughed and sneezed into the atmosphere.

The basis of design of the ultra-violet light cubicles was worked out by the author in the Laboratories for the Study of Air-borne Infection at the University of Pennsylvania. The design itself resulted from the collaboration of these Laboratories with Schmidt, Garden and Erikson, architects; Curtis Lighting, Inc.; and the General Electric Company. The building was erected by the Cradle Society of Evanston, Ill., and the operating technique and the collection of epidemiologic data will be carried out through the medical staff of this group.

While in the cubicle design for the Cradle, illustrated in the photographs, the irradiated ceiling is less essential because the walls are continued to the ceiling, ir ordinary hospital cubicle design the walls usually do not extend much beyond six feet from the floor. The same type of fixture, however, when attached to the front corners of this type of cubicle will intercept by a horizontal light ceiling the passage of organisms over the cubicle wall in the same way that the vertical light curtain prevents the passage of organisms around the cubicle wall. Installations of this type are being made in the Children's Hospital, Philadelphia, and the Infants' and Children's Hospital, Boston.

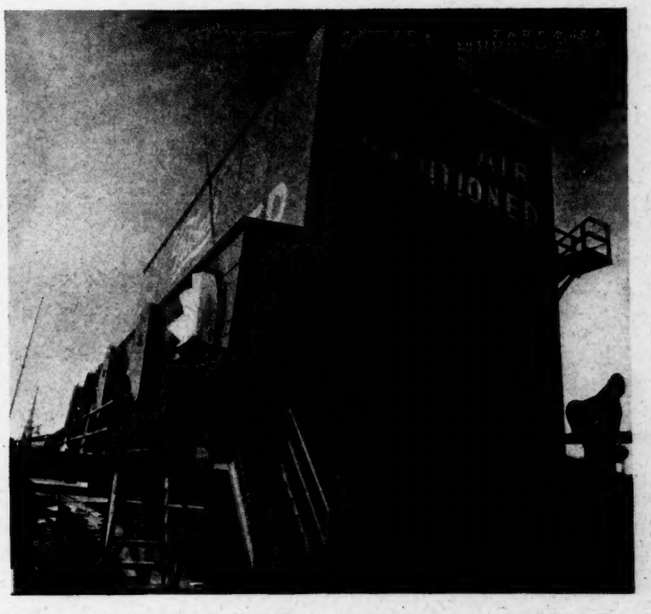
Advertising an Air Conditioned Store

SAY "air conditioning" to the average Bostonian and the name that always comes to mind is Filene's. This is because more than any other concern in Boston, and probably more than any other store in the country, Filene's sells air conditioning to its customers, day in and day out, in every possible way of advertising it.

After the system had been installed for the entire store, and had been extensively exploited in large space ads, the firm settled down to a day-in-day-out follow through to make the customer, whether a regular or a new one, continually conscious that here was an air conditioned department store, where people could shop in complete comfort throughout the entire year.

This promotion is not limited to hot weather, but is kept up the year round —in the coldest as well as the hottest. Along the face of the building fronting on three main streets runs at first-story height a permanent sign nearly two feet high, with the two words repeated, "Air Conditioned." On the roof, the huge cooling tower is similarly labeled in letters that can be read as far as a person can see over the roof tops.

Every window card always includes a mention of the air conditioning. So does every menu card in the big public restaurant. Every elevator also has a sign to the same effect.



As part of the air conditioning promotional activities of Filene, use is made of the cooling tower as an advertising sign.

Every piece of direct mail and newspaper advertisement presents the same message in at least one place, for the words "air conditioned" appear beneath the store's signature scroll, so that no advertising writer or newspaper compositor can overlook its inclusion. A booklet on the store and its history, services and merchandise, sent to all new customers, also devotes considerable space to air conditioning.

In summer these reminders are expanded to two-column newspaper ads, as these have proven effective in bringing in customers on days that are uncomfortable outside. As many as fifty such advertisements are prepared in advance and kept on file, to be used as circumstances require. These ads are institutional in character and the most effective ones are repeated from year to year. The store has its own weather forecaster and his 2 p.m. predictions for the following day are immediately relayed to the advertising and sales promotion offices for appropriate action. If need be, the proofs of the air conditioning ads are hauled out and copies sent to the newspapers to be incorporated in the advertising for the next day.

When the complete system for the entire store was put into commission several years ago, large space newspaper advertising was used, with special window displays which

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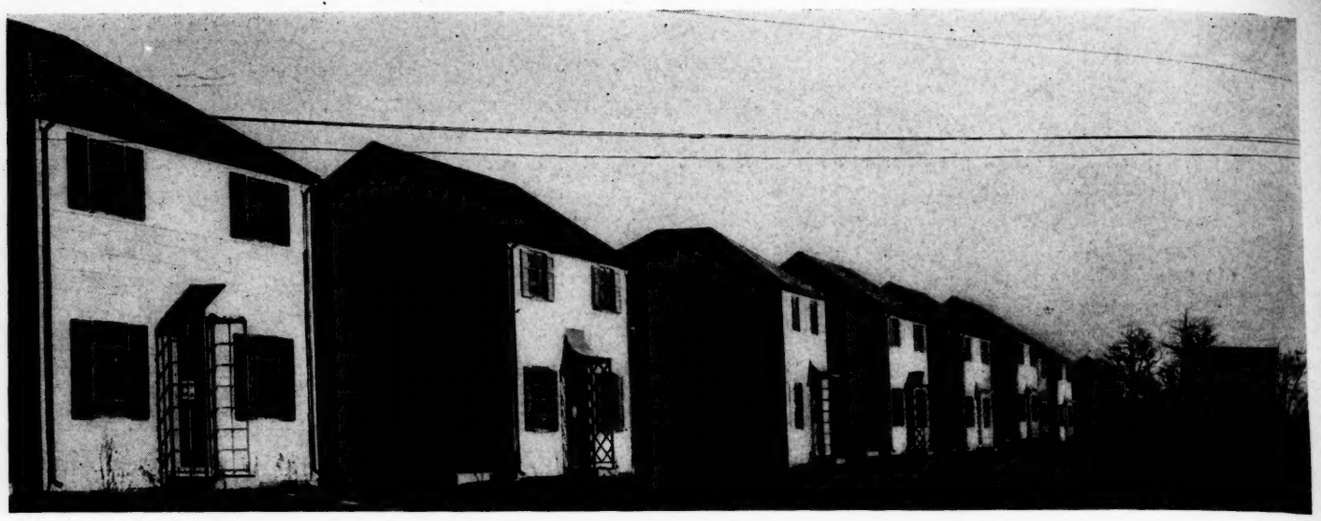


Fig. 1. Nine of the 300 houses in the Colonial Village development in Clairton, Pa.

Low Cost Dual Heating and Hot Water Supply for Colonial Village Houses

CLAIRTON, PA., is a well-known steel town located in Alleghany County and having a population of about 15,000. It is about 30 miles south of Pittsburgh on Pennsylvania highway No. 51, close to the new $46,000,000 Irvin Works of the Carnegie-Illinois Steel Company. Clairton's population consists mostly of substantial workingmen and their families, some of whom are foreign born. They are employed for the most part in the new Irvin Works or in the byproducts coke plant.

The completion of the new works with the resultant employment of many new workmen created a housing shortage in nearby Clairton and led to the development of a housing project consisting of a total of 300 single-family houses, about 200 of which have six rooms and the balance five rooms. The project is called Colonial Village and is located on high ground and rolling country.

Although only two basic plans are used, architectural monotony has been relieved to a considerable extent by reversing plans, change in orientation, and the liberal use of bright color in blinds and trim. The rolling character of the country also contributes in a large degree to the relief of "sameness." Obviously, limitation of type to only two units presents an opportunity to effect many savings in construction cost. The builders, Gilbert and Varker, engineers, have applied mass production methods successfully and have produced well-built substantial houses at a cost consistent with the income of the families for whom they are intended. The houses are selling for $4000 to $5000 and rent for $35 to $45 per month.

The Federal Housing Administration has insured the mortgage on the project under a section of the National Housing Act which permits the houses to be either rented or sold. Under this arrangement, when houses are sold the mortgage insurance is taken over by the local FHA office and handled in the same manner as any single-family house. Construction quality, therefore, is in accordance with the requirements for any single-family house financed under the FHA plan. Included in the construction are many features considerably above established minima. The walls are insulated with reflective insulation and the ceilings with mineral wool. All windows are weatherstripped and the entire construction is tight. Overall heat losses are about 40,000 B.t.u. for the five-room and 45,000 B.t.u. for the six-room house, based on a 70F temperature difference.

Gas is available at an attractive rate and offered an opportunity to provide automatic heat and hot water at a relatively low first cost. In order to effect as great a saving as possible, the heating systems were designed to combine both heat and hot water in a single unit, using not only a common burner but utilizing the domestic hot water as a heating medium. This required the use of copper pipe and convectors, which also provided a longer-lived system with no corrosion difficulties.

Although this basic principle of combining the two services has been adhered to, there are two variations utilized. The five-room houses are provided with a unit shown in Fig. 2 which consists of a side-arm heater attached to a 45-gal. copper storage tank. The input rating is about 60,000 B.t.u. A circulator controlled from a thermostat located in the living room pumps water from the tank through a system of copper pipe and fittings arranged so as to constitute a direct return system to copper convectors. Both the piping arrangement and convector locations are shown in Fig. 3. Thermostatic control on the heater permits water to be maintained from 140 to 190F. A manual adjustment is provided so that the temperature can be easily varied to

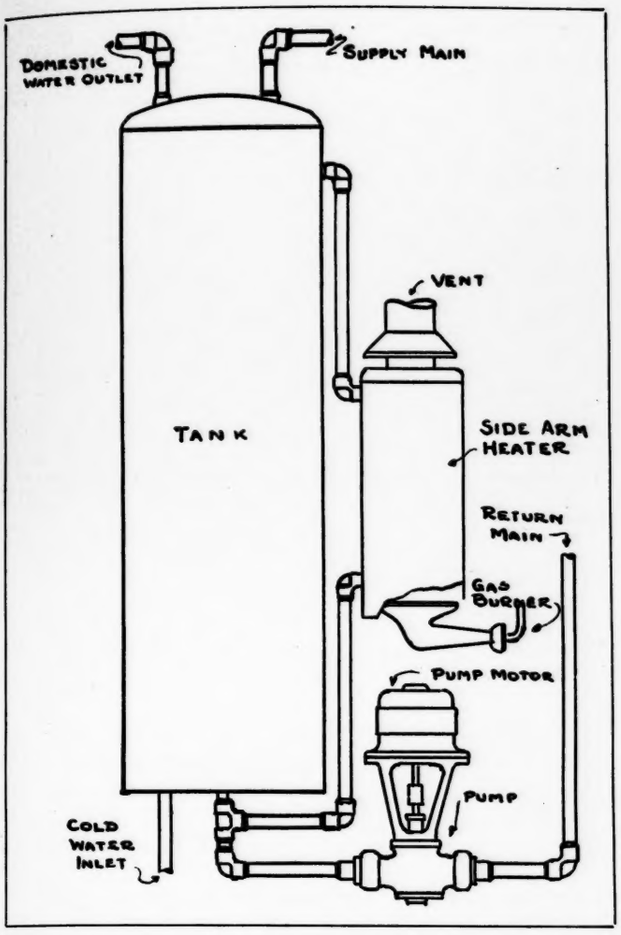


Fig. 2. Arrangement of storage tank, circulator, and heater used for heating and hot water in the five-room houses.

extend pump operation during milder weather. The radiation is designed on a 190F inlet temperature basis for extreme weather.

In the six-room house, a unit of 135,000 B.t.u. input and only nominal storage capacity is used. The entire water content of this system is less than six gallons and the small tank is made of a short length of 6-in. copper tubing. In order that the quantity of water delivered to the heater shall not exceed its capacity, an orifice is inserted in a union to limit the water supplied. The schematic layout is shown in Fig. 4. The heater itself consists of a coil of copper tubing on the outside of the combustion chamber with an extended surface passing through the hot flue gases. Thermostatic control of the temperature in the tank acts directly on the gas burner to maintain 190F in the system.

An outlet at one end of the tank is connected through an angle check valve to a header to which are connected eight individual supply lines leading to the eight convectors. Eight separate return lines extend from the convectors back to a second header, which in turn is connected to the suction side of the pump. The layout of piping and convector locations are shown in Fig. 6. The circulator is controlled by a thermostat located in the living room.

On the other end of the tank an outlet is provided for connection to the hot water main. A jet type dishwasher is included in the kitchen sink so that high temperature water is advantageous.

Experience so far has confirmed the original estimates of operating cost, which were approximately $60 for the five-room and $65 for the six-room house for year-round hot water and winter heating. Domestic water costs are obviously about the same for both houses, and the difference in heat loss is not appreciable.

If the heating of housing of this nature is to be a credit to the heating industry, operating cost and adequate performance must be given more consideration than is the case at present. The demand for good equipment at an attractive price for the lower cost home can be approximated by the tremendous demand for homes of this type. There is likewise a growing demand for individual unit systems for row houses and apartments. The schemes utilized here represent an approach to the problem of low cost automatic heating which offers an attractive opportunity for development. Combination

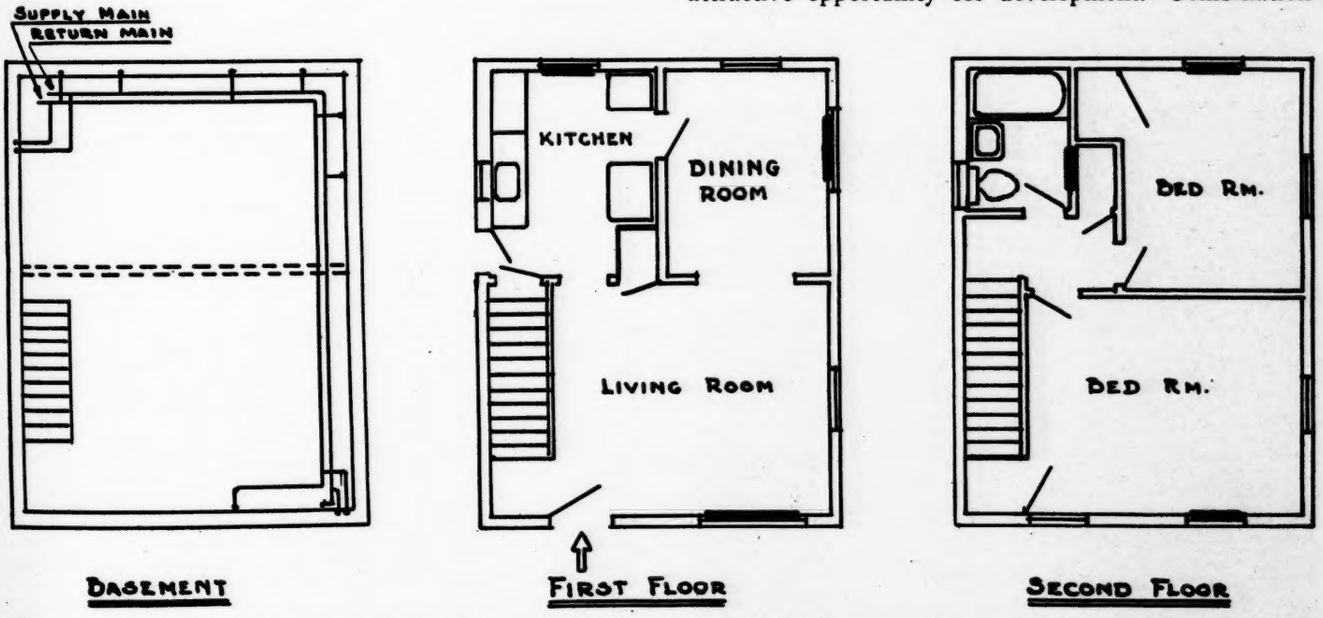


Fig. 3. Plan views of the various floors of the five-room houses heated by the arrangement shown in Fig. 2. The black rectangles indicate location of convectors.

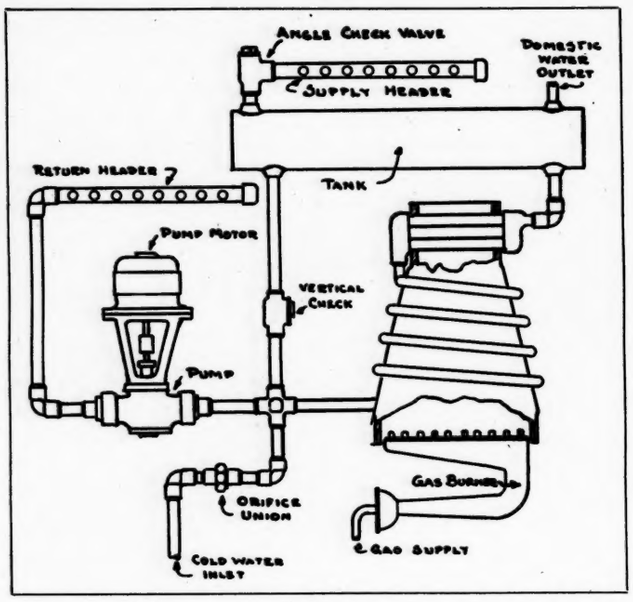
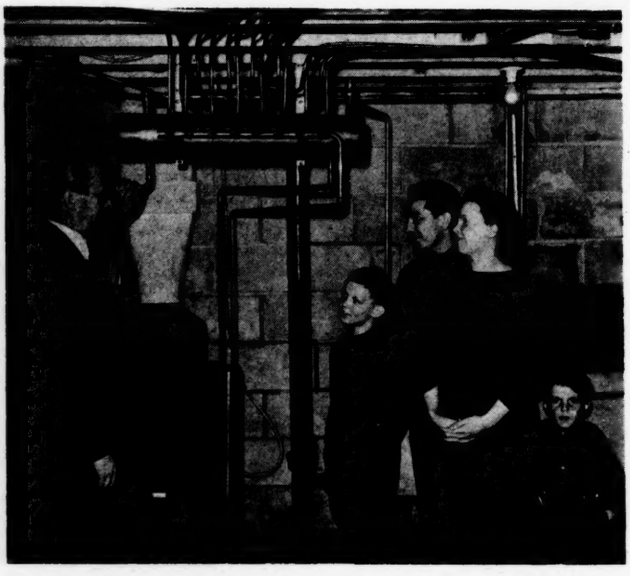


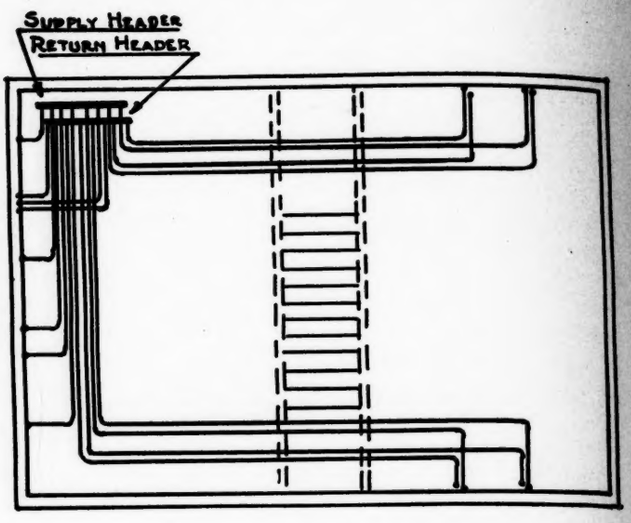
Fig. 4. Heater, circulator, tank, headers, and piping arrangement in the six-room house.

of domestic hot water and house heating whether the same water is used for both services or not should stimulate some constructive engineering thought among many manufacturers of heating equipment.

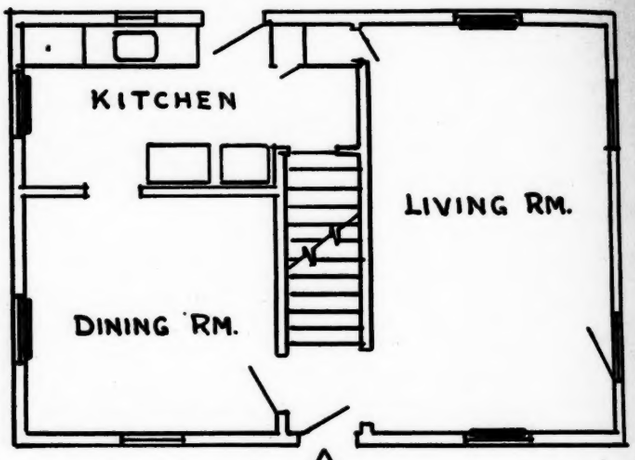
It is essential for ultimate acceptance of any scheme developed for this market that operating cost be the primary consideration, with almost equal importance assigned to performance. The third factor, but not much less important, is convenience, and convenience presupposes automatic control and automatic or at least semi-automatic firing.

In the case of the Colonial Village heating systems, operating costs of heat and hot water are, considering the standard of performance rendered, remarkably low. Maintenance likewise is low since the pump is the only moving unit involved in the system. It is possible that the use of this type of system might not be adaptable to localities where the water available is not favorable from a hardness standpoint. Introduction of fresh water of too high a lime content is apt to clog up the

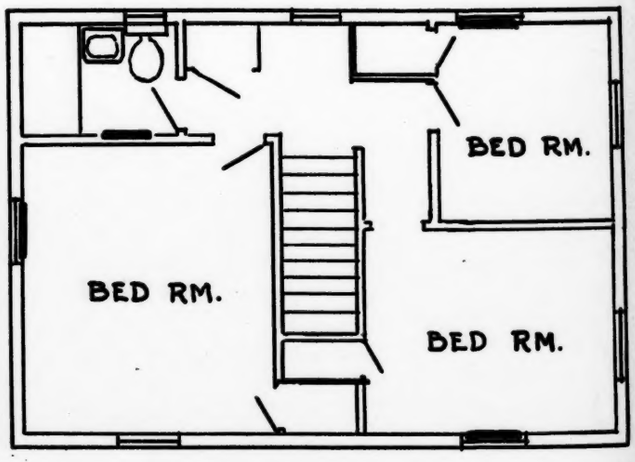




BASEMENT PLAN



FIRST FLOOR PLAN



SECOND FLOOR PLAN

Fig. 5. (Left). Tank and headers also shown in Fig. 4. Fig. 6. (Above). Plan views of the six-room houses, showing in the basement plan the piping leading from the supply and return headers. Black rectangles in first and second floor plans indicate locations of convectors.

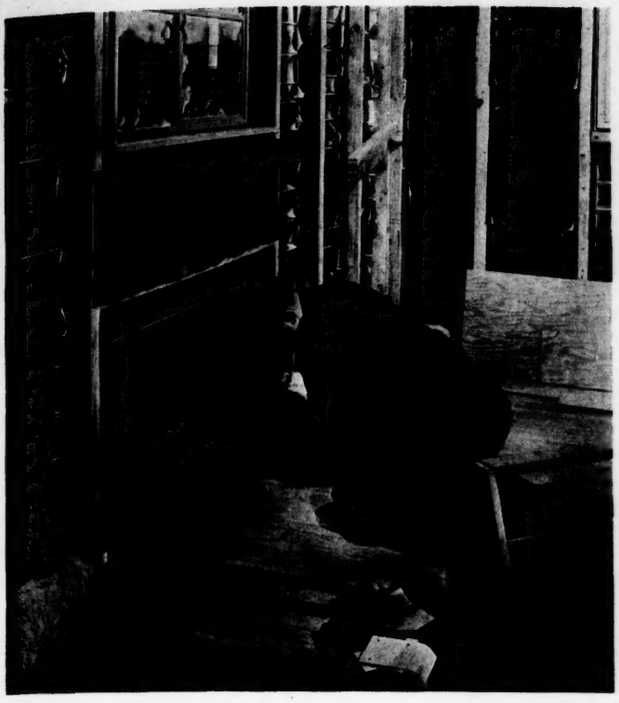


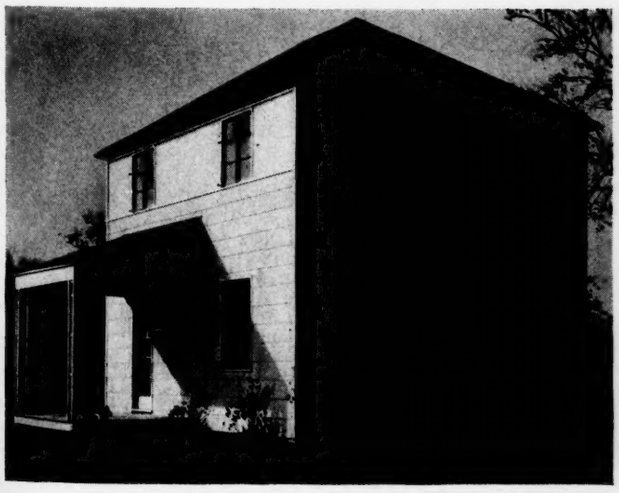
Fig. 7. Installing the convectors in one of the houses in the Colonial Village development.

heater and piping. Clairton water is not unfavorable from this standpoint, and provision has been made in the design of the heating unit for quick and inexpensive replacement should the unit itself become heavily coated.

More consideration should be given to operating and maintenance cost of a heating system than is given to the upkeep of other parts of the house for the reason that the owner or occupant is continually being reminded of these costs and the cost of heating represents the largest single item of the cost of home ownership even in moderate climates. If satisfactory heating can be provided at an operating cost within the budget of the low-income family, developments of low-cost projects along the lines of Colonial Village (that is, large developments of single-family houses) will inevitably increase in popularity. On the other hand, if the cost of heating is too great or performance is not satisfactory, this type of tenant will find accommodations in the apartment houses where heat is furnished as a part of the rent.

In no other phase of residential construction is there so little unanimity of opinion as to what constitutes minimum heating performance. Those minimum requirements for housing about which there seems to be almost universal agreement specify the amount of light or window area in terms of floor area, and in most cases these minimum requirements have been exceeded by 50% or more. There is no appreciable disagreement about the area of rooms required as a minimum. The Federal Housing Administration, U. S. Housing Authority, and most of the government agencies concerned with housing require running water inside the house as well as an inside toilet, and state and city codes specify minimum requirements for sanitation and health. The specifications for construction covering the size and span of beams, studs, girders, and rafters are never seriously challenged. Yet, when minimum requirements for heating are considered, there is a surprising variation of opinion, with the result that the old-fashioned parlor stove is often looked upon with favor even in the coldest climates. It is regrettable that this condition exists, and yet the responsibility for it must be placed largely in the lap of the heating industry.

It must be borne in mind that American interest in good quality low-cost housing is comparatively new. Guiding influences in this development have very naturally fallen into the hands of the architectural profession for the most part. Experience of architects in the design and construction of houses of more expensive class has developed an unfortunate habit on their part of budgeting the various items which go to make up a house in terms of per cent of the total cost. When their experience has shown that the cost of heating a $10,000 house is about 7 per cent, or $700, they have assumed that the cost of heating a $3,000 house should not be over $200. On the other hand, there has been no concerted effort to beat down the cost of plumbing for the



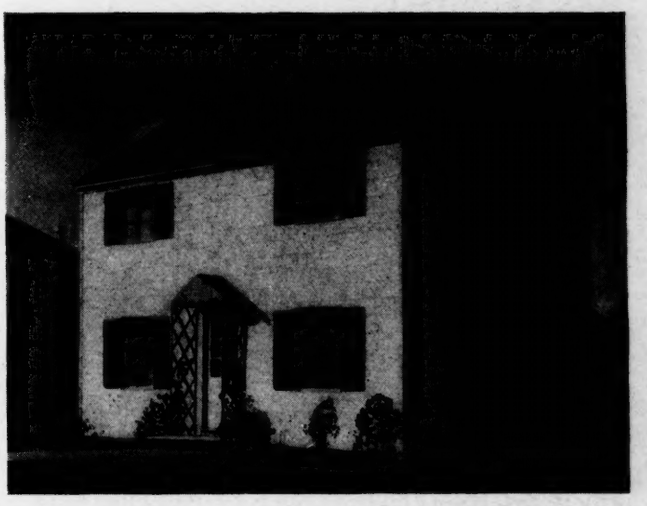


Fig. 8. (Left). One of the five-room houses heated by the arrangement shown in Fig. 2. Fig. 9 (Right). One of the six-room houses heated by the arrangement shown in Figs. 4 and 5.

$3,000 house to the same percentage which it amounts to in the case of the $10,000 house. In the case of plumbing, where no sacrifice of performance is considered, a minimum plumbing system might conceivably cost the same amount of money for a $3,000 house as it would for a $10,000 house.

The heating systems used at Colonial Village were installed for approximately $200 with little difference in the two systems in this respect. They, therefore, represent an exceptionally interesting criterion in this respect. The use of gas has helped decidedly to keep the first cost at a minimum. Had gas not been available or had its price been unfavorable, and had automatic coal or oil burning equipment been included, the first cost of heating would of course have been considerably greater. Even so it is possible that this additional cost would be justified and not altogether unreasonable considering the provision of automatic and convenient heating.

Because there is no minimum standard of performance established by the heating industry, a great many low-cost housing developments which are standard in every other respect are equipped with what might be considered sub-standard heating devices. Adequate heating performance depends very definitely upon the construction of the house from the heat loss standpoint. If heating systems which provide a high degree of performance are to operate economically within the limits of practical efficiencies, the construction and design of the house itself must be considered more seriously from the standpoint of heat loss. A compromise between minimum standards of light and ventilation and heat loss through windows must be arrived at. Wall and ceiling construction, which serve to reduce heat loss, must be considered an essential part of the economic aspect of design. If minimum requirements for the performance of heating equipment are established, the most powerful influence in their acceptance will be operating economy. It is conceivable that such minimum requirements might vary according to locality. Certainly the operating cost will vary according to locality. In providing for thermostatic control, automatic firing, and what appears to be a reasonable operating and first cost, the heating systems at Colonial Village represent an accomplishment which might well serve as a standard of comparison.

Air Conditioning Experiences of a Building Superintendent

AT a recent convention of Southwest Building Owners and Managers, J. W. Stiles, building superintendent of the Second National Bank Building of Houston, Texas, told of some of his experiences when the building was completely conditioned recently. Some abstracts from Mr. Stiles' talk follow:

The building was built in 1910, has been in operation 28 years, and is one of the older buildings in the city. At the time of this installation, the building was fully occupied, and is fully occupied today. There was, therefore, no question involved of air conditioning to attract new tenants, or to hold old ones. The question before us, then, was simply one of keeping up with, or a little ahead of, the march of progress.

Our management decided against going to the tenants at all for their attitude in the matter, but to go ahead, let the contracts, and then announce the program. This was done, and though some few tenants had noticed the engineers measuring and checking through the building, and had asked some questions, the announcement was a surprise to most of the tenants and, no doubt, was somewhat of a shock to a few of them.

It has been truly said that anyone who expects to completely satisfy everybody the first year or so under air conditioning must be at least fifty per cent diplomat, seventy-five per cent psychologist, and one hundred per cent optimist.

Our management thought that the time to start with the diplomacy and the psychology was right at the beginning, so the announcement of the intention to air condition was made in a form letter, sent to each tenant on May 1 stating that air conditioning would be installed throughout the building; that work would start within thirty days; and that conditioned air would be turned on September 1. Notice was given that under air conditioning rental rates would be advanced about 20% (or actually four cents per square foot per month) but not until April 1 the next year. The fact was stressed that in the meantime, the tenant would have had nearly a month of hot weather in which to try a free sample of cooling, and all winter to experience the heating under the all-year-round system we intended to install.

On the whole, the reaction to the air conditioning idea was favorable. An anticipated 80% for, to 20% against, ratio proved to be nearly correct, though I don't believe quite 20% of our tenants registered really firm opposition. On the other hand, comparatively few were enthusiastically for it, either. The great majority were open-minded, and decided that, as long as it did not cost anything, they would wait and see. That was exactly what we wanted, as we felt sure we could please them if given a chance. In the month or so prior to the April 1 deadline, when the advanced rates were to go into effect, some half dozen vacancies occurred. This was somewhat more than the normal movement, but only one of the number would admit that air conditioning or higher rates prompted his move. The others gave other good and logical reasons for moving out. The space thus made available was immediately taken by others perfectly willing to pay the price for air conditioning, and numerous applications from tenants in unconditioned buildings were turned down because of lack of available space.

That is the story of the acceptance of air conditioning in our buildings. We think it a very good record.

We feel that an overwhelming majority of our tenants are now sold on air conditioning, and have accustomed themselves to the new rates, and are not likely to move.

Oil Burner Standards Revised

APRIL 27 is the date set for a public hearing in Washington on the proposed commercial standard for automatic mechanical draft oil burners designed for domestic installation, according to I. J. Fairchild, Chief of the Division of Standards, National Bureau of Standards.†

At the hearing, open to manufacturers, distributors, installers, contractors, architects, consumers, and others interested in the oil burner industry, it is expected that the final form of the proposed commercial standard will be ratified for mail submission to the industry. Acceptance of 65% of the productive capacity of the oil burner industry would result in adoption of the standards.

Meeting March 15 at Washington, manufacturers and distributors made minor changes in the proposed form of the standards and ratified a schedule outlining oil burner installation test procedure. More than 100 representatives of the industry attended the meeting, at which the proposals were considered in detail and either adopted or amended.

Following are the principal revisions made March 15 to the preliminary standards:

It was decided to limit the standards to *automatic* mechanical draft oil burners *designed for domestic installations.*

In connection with test procedure, a revision provides for the addition of the following: *Motors shall be provided with an overload and thermal safety cutout.* Paragraphs relating to test procedure in connection with radio interference and quietness were eliminated and now merely call for the burner to be reasonably free of sound and radio interference.

In connection with the burner's performance the revision provides that, under CO_2 rating, the burner should be capable of producing and maintaining CO_2 of not less than 10% without smoke at *all* oil rates *within the manufacturer's rated capacity.*

Three additional paragraphs were added to the standards as follows:

Oil Burner Installation Test Procedure

19. *Equipment.*—There shall be available on each oil burner installation the following equipment before tests are started:

19(a) Where oil rate is not indicated on nozzle tip a suitable device for determining the rate in terms of gallons per hour fed to the burner shall be used. This may be in the form of a graduated glass vessel.

19(b) A suitable flue gas analyzer for determining the per cent CO_2 in the flue gases.

19(c) A suitable draft gauge reading in inches of water.

19(d) A suitable thermometer for reading the flue gas temperatures.

19(e) Provision for inserting a thermometer into the flue pipe as follows: 12" from the boiler or furnace outlet, measured on the center line of the flue pipe, there shall be a hole not more than ½" diameter and located at the side of the pipe on the center line so that the thermometer may be inserted horizontally. The thermometer is to be placed so that the bulb is ¼ of the pipe diameter from the near side of the flue pipe. The opening around the thermometer stem is to be sealed to prevent air leakage. This same opening may be used for checking draft and sampling flue gases.

Note: Thermometer readings taken in this manner on insulated flue pipes may be approximately 50°F higher than for uncovered flue pipes. Stock temperature is largely controlled by boiler design. High stack temperatures do not necessarily condemn the burner.

19(f) In addition to the above, provision shall be made on the boiler or furnace for inserting a small tube into the combustion chamber for checking draft. This opening shall not exceed the equivalent in area of a ½" diameter round hole. (¼" pipe tap.)

20. *Test Procedure.*

20(a) The burner is to be operated and the fuel rate adjusted to that required for the installation.

20(b) The draft is then to be adjusted to meet the burner manufacturer's specifications for over the fire and at the breeching.

20(c) Combustion air adjustments are to be made to give the best CO_2 without visible smoke at the chimney. If minimum CO_2 cannot be obtained in the breeching, it will be permissible to take CO_2 over the fire, which will be acceptable. In that event both CO_2 readings shall be recorded on the certificate. A considerable difference between the two CO_2 readings will indicate a boiler leak.

20(d) Record stock temperature after 10 minutes of operation after reaching steaming temperature for steam boilers, or 180°F water temperature for hot water boilers, or 125°F bonnet temperature for hot air heating plants.

21. *Readings.*

During the period of operation to permit flue gas temperatures to reach maximum, periodic readings of draft, CO_2 and oil rate shall be taken and the average recorded on the certificate. All controls and limiting devices shall be checked for proper operation.

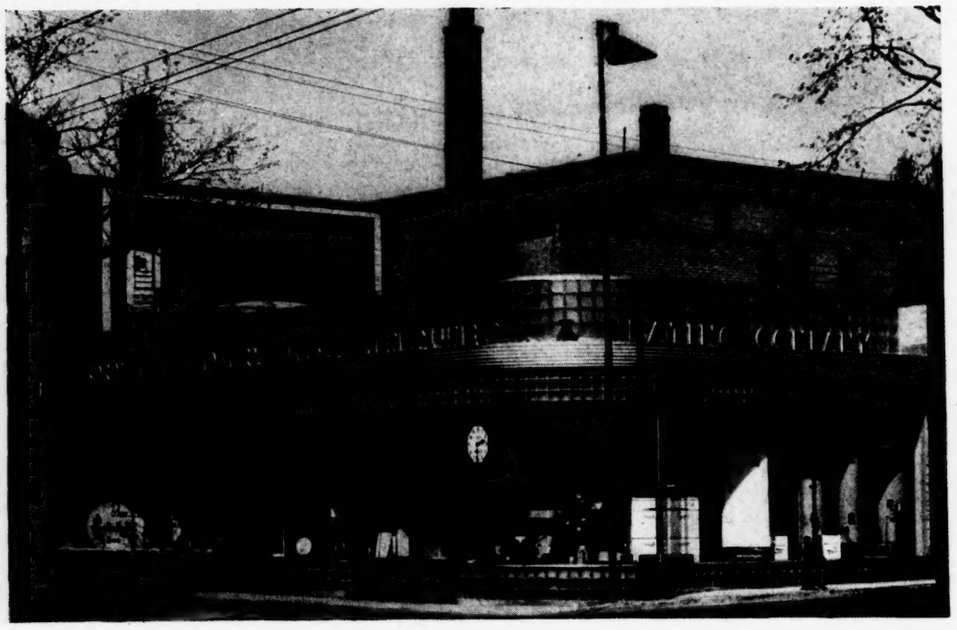
†These standards in preliminary form were printed on page 47 of the March issue of HEATING & VENTILATING.

Smoke Abatement Pays Dividends

HUDSON County, N. J., fuel users saved $244,000 last year as a result of smoke abatement activity, it was announced here March 7 by William G. Christy in a portion of a report on 1938 progress of the county smoke abatement campaign which he directs. His report further showed that the accumulated savings for the previous seven years, prior to 1938, amounted to $1,535,000. This makes the total for the eight years since the smoke abatement campaign started $1,779,000.

This sum, Mr. Christy stated, represents additional value of fuel, which would have been burned in Hudson County had it not been for the smoke abatement campaign. The largest item in the estimate is $85,090, which represents the saving in the fuel used in heating plants. Industrial plants are next on the list, with reported savings of $62,430. In addition there is an item of $29,127, representing the saving made by mechanical firing equipment.

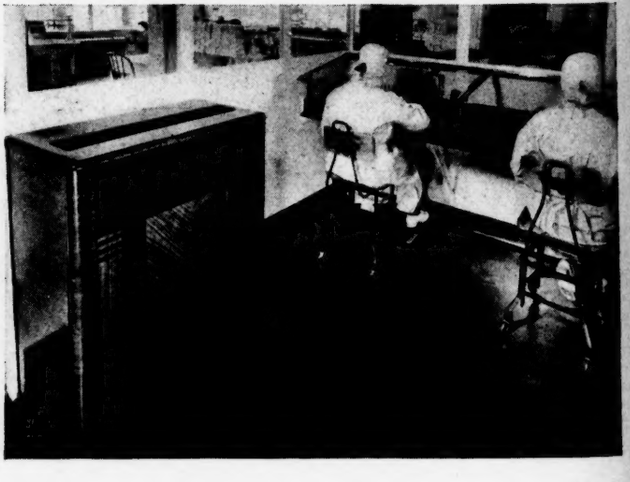
PICTURE PARAGRAPHS



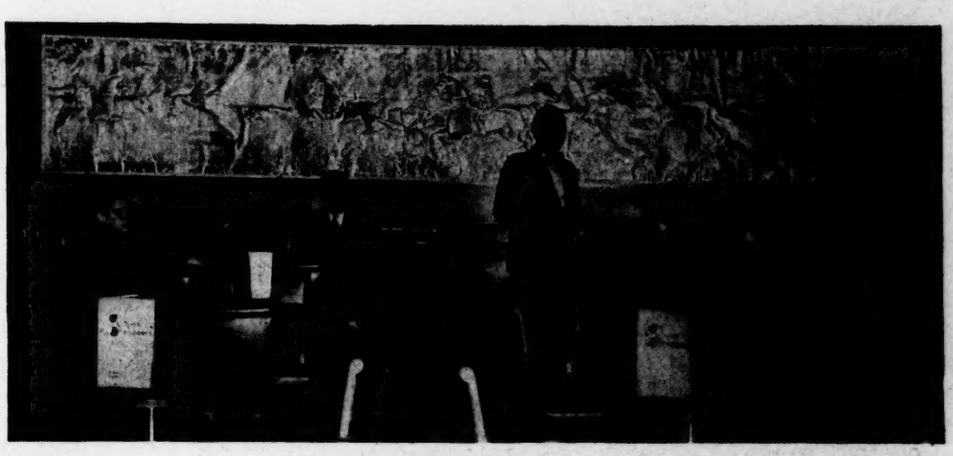
Glass block shops. Zien Plumbing and Heating Company in suburban Shorewood, near Milwaukee, is housed in this one-story structure entirely fronted by glass. Photo courtesy Owens-Illinois Glass Company.

Hot water heat is advertised on the trucks of a motor transport company. This mobile advertisement urges readers to get in touch with local contractors.

(Left) Fuel engineer conducting dustiness tests on soft coal. He is collecting the dust which settled on a stainless steel slide and will weigh it in order to determine the effectiveness of oil treatment in eliminating dust. Photo by Bituminous Coal Research, Inc. (Below) Cobra venom is packed in ampules in this room in the Hynson, Westcott and Dunning plant in Baltimore. The room has now been air conditioned by the unit shown at the left in order to prevent minute dust particles from being packed with the venom.

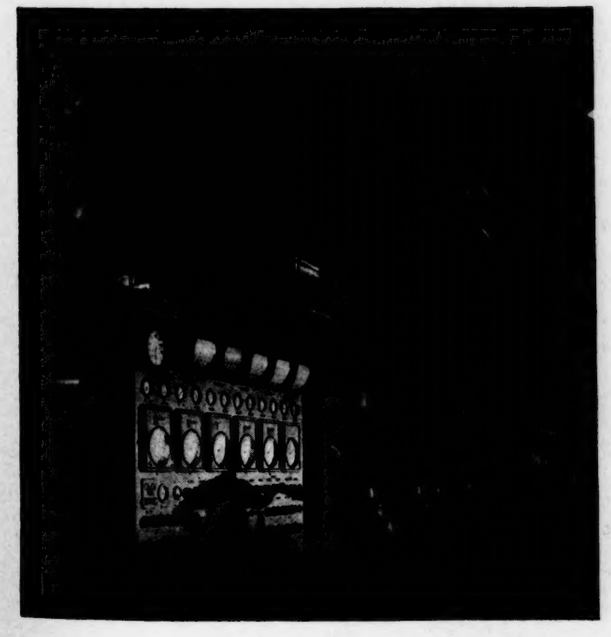


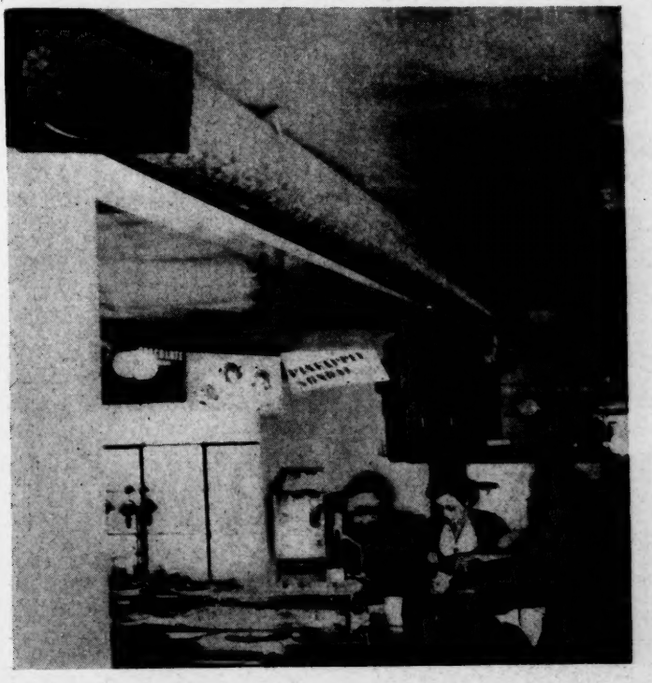
(Right) Paddock Room of the air conditioned "Sam's Diner," Springfield, Mass., probably the first air conditioned "diner" in the east. In the background is a 20-ft. hammered copper panel depicting hunting scenes.



Home-made incubator made from soil-heating cable, thermostat, and ordinary bassinet for baby William Pierce Rambo, Oakland, Calif. When premature birth necessitated incubation, William's father, an electrical engineer, arranged the cable around the bassinet to maintain 80F.

(Above) Another view of the Paddock Room showing the supply grilles overhead and to the right. The black rectangles are spotlights and not grilles.





(Above) In order to reduce window condensation and to provide more heat in the vicinity of the window, the unit heater in a Grand Rapids restaurant was provided with a bonnet and duct to direct heated air to the window. (Left) Modern boiler room of the Duquesne Light Company's James Reed station on Brunot's Island near Pittsburgh's Golden Triangle. Westinghouse stokers 23 ft. long fire the boilers.

How to Overcome Condensation in Building Walls and Attics

By L. V. TEESDALE†

Modern tight construction of buildings and use of humidifying systems both result in higher winter relative humidities indoors as compared with those outdoors. Consequently, condensation of moisture within the walls frequently occurs in cold weather, causing water stains, decay, loose plaster, and paint failure. The author discusses the problem, gives data on the resistance of different materials to vapor transfer, and concludes with recommendations for the solution of the problem. This article is abstracted from a paper presented by the author before the Conference on Air Conditioning at the University of Illinois, March 8-9.

CONDITIONS under which condensation might develop within walls or in attics of buildings, and methods of protection or prevention should be understood by anyone interested in winter air conditioning, particularly for buildings north of the Ohio River.

The question naturally arises as to why condensation should be more of a problem today than it used to be. Strange as it may seem, the cause is the result of certain improvements intended to increase the comfort of the occupants and decrease operating expenses. Such improvements include thermal insulation, weatherstrips, storm sash, calking around windows and doors, and other means of decreasing heat loss and wind infiltration. Because of the tighter building construction the normal relative humidity within a house so constructed will be higher than in houses less tightly constructed. In addition, as a health and comfort measure, modern homes are usually provided with some means of increasing the normal humidity either through the heating system or by some auxiliary method. These worthy improvements in construction and equipment that increase comfort and health and decrease operating expenses are the factors mainly responsible for the increase in the condensation problem. To enjoy the advantages of such improvements without suffering the disadvantages, certain protective measures should be provided.

Most of the trouble occurs in homes where the relative humidity is maintained at over 40%, in which case there may be evidence of condensation after every cold snap. On the other hand, many homes only show evidence of condensation during or after periods of excessively low temperatures, such as occur once in three or four years.

The relative humidity in homes varies widely depending upon a variety of factors, principally outdoor temperatures. The average humidity for varying outside temperatures as determined from the average moisture content of wood samples is illustrated in Fig. 1. This illustrates how the relative humidity or vapor pressure inside varies more or less directly with the temperature outside. Also that where automatic humidity control capable only of raising the humidity is used the minimum humidity is fixed during cold weather, but humidity may be higher than the minimum during periods when outside temperatures are mild. The amount of water evaporated from pans in very mild weather is small, but as the outdoor temperature drops the amount increases. For example, in one case only about 1 qt. is used per 24 hr. when the outdoor temperatures average 45F, but 2½ gal. are used when outdoor temperatures are about zero. The amount required to maintain a fixed minimum humidity of 40% at zero as illustrated in Fig. 1 would be very much greater.

Most building materials, including plaster, wood, concrete, most kinds of brick, and various building papers, are permeable to vapor. The rate of vapor movement from one point to another is more or less proportional to the difference in vapor pressure between the points and inversely proportional to the resistance of the interposed materials. Walls of conventional house construction are composed of a variety of materials varying in permeability. Also the temperature gradients through a wall drop step by step according to the thermal properties of the material and the difference

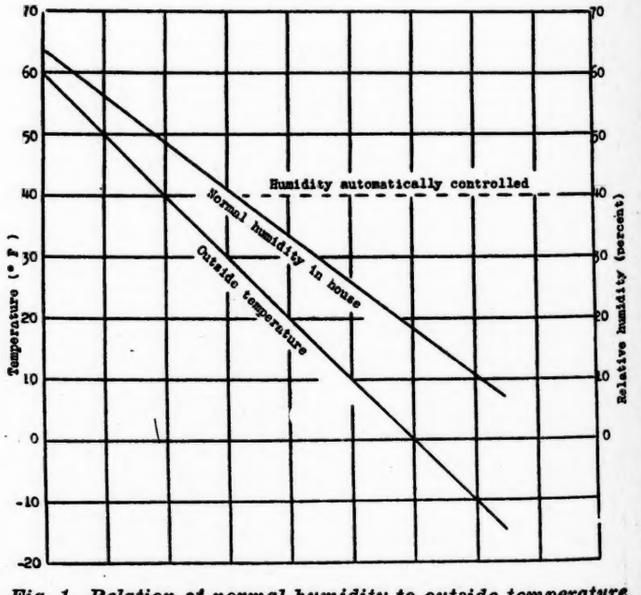


Fig. 1. Relation of normal humidity to outside temperature. Corresponding temperatures and humidities will be found, on their respective curves, in vertical alignment.

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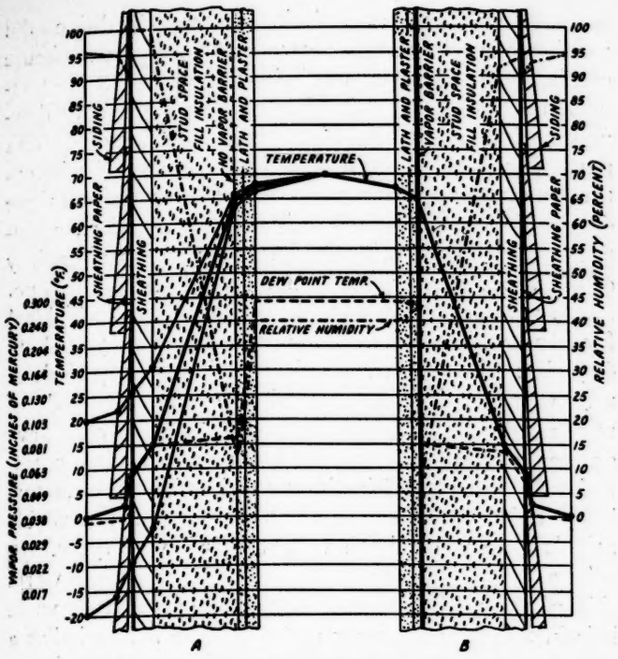


Fig. 2. Section of conventional frame wall with fill insulation showing temperature, dewpoint, and relative humidity gradients without vapor barrier (A) and with vapor barrier (B).

in temperature between the warm interior and the cold exterior. Should the temperature at any point within the wall, as for example, at the inner face of the sheathing, fall below the dewpoint temperature of the room side of the wall condensation would take place at that point.

A house wall typical of many insulated forms of construction is illustrated in Fig. 2-A.This wall has lath and plaster on the inside and sheathing, paper, and bevel siding on the outside. Fill insulation occupies the entire stud space. Indoor conditions are assumed to be: temperature 70F and relative humidity 40%; the dewpoint for these conditions is 44F and the water vapor pressure 0.295 in. of mercury. Temperature gradients through the wall are shown in solid black for three outdoor temperatures, namely 20F, 0F, and minus 20F. Actual gradients in any individual wall of this type may be expected to be very similar to these. Much work has been done on this subject by many agencies and the facts are well established. Much less work has been done on vapor movement through walls and associated phenomena and we are much less sure of our ground. However, currently collected data indicate that, under the assumed conditions (outside temperature 0F), the temperature of the inner face of the sheathing very largely controls the dewpoint within the entire stud space. It appears that condensation upon this face, which is well below the dewpoint of the atmosphere in the room, serves to lower the dewpoint within the stud space. Just how much lowering takes place we do not know for sure. It seems apparent, however, that at the boundary conditions, the dewpoint temperature throughout the stud space would be the temperature of the inner face of the sheathing. The relative humidity gradient corresponding to the illustrated dewpoint gradient is shown as a dot and dash line in the figure.

The amount of condensation that can develop within a wall depends upon the resistance of intervening materials to vapor transfusion, differences in vapor pressure, and time. Ordinary plaster and lath have comparatively low resistance. If the plaster is finished with paint the resistance is increased somewhat. High indoor vapor pressures are associated with high relative humidities and high temperatures. Low outdoor vapor pressures always exist at low temperatures, since even the saturate vapor pressures are low at low temperatures. Weather conditions are not static and the duration of critical conditions varies widely with the time of year and the severity of the weather. During long continued cold spells, such as the six weeks low temperature period in January and February, 1936, the condensation problem becomes acute, a large number of homes being affected. In the winter of 1937-38 there was only one day at Madison, Wis., when the temperature was below zero, though there were about 90 days in which it averaged below 20F. Though the number of homes affected by condensation would be less during the mild winter conditions, many cases were reported. Where information was available it appears that the minimum humidities in the affected houses exceeded 35% and generally were higher.

In Fig. 2-A we assumed a boundary condition in which the dewpoint temperature in the stud space was absolutely controlled by the temperature of the inner face of the sheathing, and there was a sharp drop in dewpoint temperature through the lath and plaster. The rate of vapor movement and the rate of condensation on the sheathing would be comparatively high on account of the low vapor resistance of lath and plaster. In Fig. 2-B we have placed a vapor barrier between the studs and the lath. This barrier greatly reduces the rate of vapor movement through the wall, and thus very materially reduces the possibility of trouble from condensation. What actually happens to vapor which finds its way through the barrier depends largely upon the vapor resistance of that part of the wall outside of the studs. If, for instance, the sheathing paper be an excellent vapor barrier one may expect most of the vapor to condense on the sheathing or sheathing paper, just as it did under the conditions we selected for Fig. 2-A. If, on the other hand, the vapor resistance of sheathing paper and siding be very low, most of the vapor may escape to the outside atmosphere without condensation. We have chosen to illustrate this condition in Fig. 2-B by showing the dewpoint temperature (the dotted line) as always below the atmospheric temperature. It must be obvious that as close an approach as possible to this ideal condition is desirable from the moisture standpoint, and our present tentative recommendations call for high vapor-resistance on the warm side of the wall, and low vapor resistance on the cold side. These recommendations will doubtless be modified in detail as we learn more about the whole subject and specially about the extent to which rain driven under the siding by the wind is a factor.

Fig. 3-A shows the calculated temperature gradients through an uninsulated wall and 3-B through a wall having ¾-in. fiberboard sheathing in place of wood sheathing. As the heat loss through walls of those types is greater than through walls containing fill insulation, the sheathing temperatures are higher than those shown on Fig. 2-A and, consequently, the vapor pressure dif-

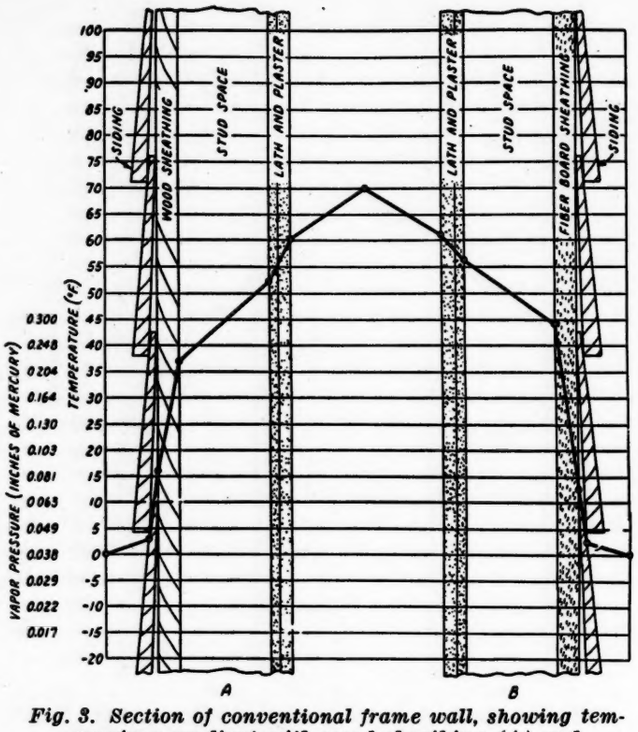


Fig. 3. Section of conventional frame wall, showing temperature gradient with wood sheathing (A) and with ¾-in. fiberboard sheathing (B).

ferences are reduced accordingly. This in turn means that less condensation would occur at the same outside temperature in walls of these types than where fill insulation is used, other factors being alike.

Tests have been made to determine the comparative vapor resistance of various papers and wall materials used in building construction. Samples were sealed in copper pans containing water and exposed in a room controlled at 80F and 30% relative humidity and weighed regularly for 90 days or more. The values obtained after the rate of loss became constant were calculated on a basis of grains of moisture lost per square foot per hour, and are presented in Table 1.

Table 1 is only a partial list of the materials tested up to the present time, and as the tests are incomplete, it will be subject to change as required with further work. Many of the materials have been tested under actual exposure conditions in laboratory test-house wall panels.

Fig. 4 shows the moisture content of the sheathing in three test wall panels, differing only in type of vapor barrier used. These walls were of conventional frame construction, lath and plaster, stud space filled with rock wool, wood sheathing, asphalt impregnated and surface coated sheathing paper and siding. Panel No. 1 had a vapor barrier made of aluminum foil mounted on paper; No. 2, asphalt impregnated and surface coated sheathing paper weighing 50 lb. per roll of 500 sq. ft.; and No. 3 had no special barrier. Starting about November 1 the sheathing shows a gradual increase in moisture content for each type, fastest where no barrier is used. Even with a barrier there is a definite pickup until in the case of No. 2 a moisture content of about 17% is reached, indicating that the inflow of water vapor exceeds the outflow until a certain balance is obtained. After that time conditions were nearly static until the outside weather conditions moderated and then the outflow exceeded the inflow. Conditions did not become static in the case of No. 3, the moisture continuing to build up until the change in outside temperature raised the sheathing temperature above dewpoint. After that time No. 3 began to dry out. This particular panel was quite badly blue stained whereas the other two panels were clean and bright. From these data and other observations it appears that for conventional frame walls with fill insulation the permeability of the vapor barrier should not exceed 0.600 grains per sq. ft. per hr. on a basis of the values given in Table 1 for houses where humidities are maintained at or about 40% in normal winter weather having short periods of zero weather. Where exposed to extended periods of weather below zero the vapor barrier should have greater resistance. For walls having less insulation, less resistance is required in the vapor barrier, other factors being alike. However, enough data are not available at this time to establish values for all wall types.

The barrier, when located as described on the warm side of the wall, resists the passage of moisture while it is in the form of vapor and therefore before it has a chance to condense into water. Hence, there is no hazard of water forming behind the plaster or other interior wall finish. The barrier also prevents moisture from getting into the wall or attic space during the construction period, particularly during the plastering operation.

For new construction, vapor barriers of highly resistant paper are effective and economical. They should be applied vertically on the interior portion of exterior or exposed side walls with edges lapping on the studs after the insulation is installed and before lathing. Horizontal joints should be made only where backed up with a plate or header. The barrier should be brought up tight against electric fixture outlets, air

TABLE 1—COMPARATIVE RESISTANCE OF VARIOUS MATERIALS TO VAPOR TRANSMISSION

Material	Loss in Grains per Sq. Ft. per Hr.
Foil surfaced reflective insulation (double faced)	0.061- 0.093
Roll roofing—smooth surface—40 to 65 lb. per roll 108 sq. ft.	.093- .123
Asphalt impregnated and surface coated sheathing paper glossy surfaced—	
50 lb. 500 sq. foot roll	.153- .555
35 lb. 500 sq. foot roll	.123- 1.480
Duplex or laminated papers 30-30-30	.990- 1.850
Duplex or laminated papers 30-60-30	.370- .617
Duplex papers reinforced	.493- 1.480
Duplex paper coated with metal oxides	.370- .930
Insulation backup paper, treated	.617- 2.462
Gypsum lath with aluminum foil backing	.061- .277
Plaster—wood lath	7.90
Plaster—3 coats lead and oil	2.650- 2.770
Plaster—3 coats flat wall paint	3.080
Plaster—2 coats aluminum paint	.831
Plaster—fiberboard or gypsum lath	14.20-14.80
Slaters felt	3.700-18.50
Plywood—¼" Douglas fir, soy bean glue plain	3.080- 4.620
2 coats asphalt paint	.308
2 coats aluminum paint	.930
½" 5-ply Douglas fir	1.920- 1.975
¼" 3-ply Douglas fir, art. resin glue	3.080- 4.620
½" 5-ply Douglas fir, art. resin glue	1.975- 2.420
Insulating lath and sheathing—board type	18.50 -24.65
Insulating sheathing, surface coated—3/16 compressed fiber board	3.640
1" insulating cork blocks	4.440
½" and 1" blanket insulation between coated papers	1.380- 1.440
4" mineral wool—unprotected	20.950

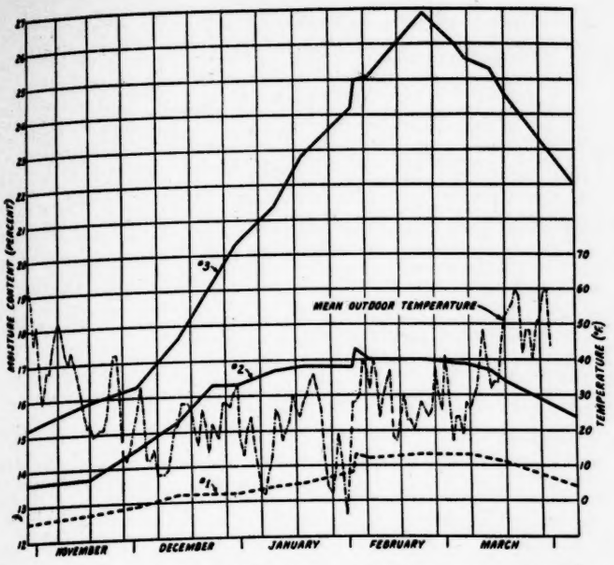


Fig. 4. Curve showing moisture content of wood sheathing during the winter of 1937-38 in laboratory test house with and without vapor barrier.

registers, door and window frames, and other similar openings. If wood lath, metal lath, or other types requiring a plaster key are used the paper should be applied slightly loose so that the plaster can push the barrier back to form the key. Where the ceilings below the attic or roof are insulated the barrier should be applied in a similar manner.

Walls finished with such materials as plywood, fiberboard, plaster board, and the like, should also have the barrier as described. Sheathing paper when used outside of the sheathing in combination with the moisture barriers described should be water resistant, but not very vapor resistant so that the small amount of water vapor that may leak through the barrier can escape outward. We now believe that slaters felt meets this requirement very well.

Some kinds of mineral wool are relatively resistant to water absorption, others are treated to make them resistant to wetting by water. This property, while desirable, does not make these materials resistant to the passage of vapor. Therefore, unless additional vapor-resistance be provided, they should not be considered a source of protection against condensation.

Some types of mineral wool have a vapor-resistant paper back attached to the bat. Tests to date indicate that these papers average somewhat below the resistance previously specified. They are sufficiently resistant, however, to be of definite help in keeping the insulation and the wall dry and to warrant proper care in installation. The wool bat is made to fit between standard stud, joist, and rafter spacing with tabs on the paper which extend out from the bat and are tacked to the studs or rafters. The bat may be cut or forced back to obtain the tabs at the end of the bat. Where the spaces are not standard between studs, such as occurs around windows, doors, and dormers, particular care should be taken to obtain good joints even if it is necessary to use one of the barriers previously described. As yet no suitable provision has been made for sealing the horizontal joints between adjacent bats in the individual stud spaces. Unfortunately we do not know at present just how much protection is needed at this point.

Blanket types of insulation are also available where the insulation is enclosed within a heavy paper covering treated with asphalt. Insulations of this type come in various thicknesses, and the vapor-resistance of the enclosing envelop can be built up to almost any desired point. It is important that this type of insulation be carefully installed so that vapor cannot work through around the edges. The tabs should be nailed to the face of the studs with the insulation looping loosely inward away from the inner face of the wall or if installed between studs it should be fastened in place with wood strips.

Fiberboard sheathing is often used as a substitute for wood sheathing and it may be used either with or without other insulation. When used with other insulation the methods of protection suggested should be followed. When no other insulation is used the need of a moisture barrier is much less, just as with wood sheathing.

Materials embodying the principle of reflective insulation are in use, but opportunity for observation and tests have been limited. One type having metal foil attached to both sides of a heavy sheet of paper is very resistant to vapor and another type composed of a strong paper faced on both sides with metal oxides is also very effective in resisting vapor transmission.

It is also possible to so construct walls that the vapor could pass outward through sheathing and sheathing paper and escape through openings in the outside wall covering or be carried away by ventilating the space between the sheathing and outside finish. Standard construction does not lend itself to this method of moisture elimination. One possible method for wood siding would be to place 1 by 2 in. furring strips over the sheathing, thus obtaining a vertical ventilating space approximately of ¾ in. which should be open to the outside at both the bottom and top of the wall so that air could enter at the bottom and pass out at the top. The openings could be concealed behind, but not covered by mouldings or other treatment at the water table and cornice. Similar ventilation could be adapted to stucco, brick, and stone exteriors. With this method the sheathing paper should be of a type that passes water vapor readily, such as slaters felt. During periods of protracted cold weather it is quite possible that moisture would accumulate in the wall faster than it could pass through and be removed by ventilation, hence the ventilation method might not assure complete protection. So far, the possibilities in this method have not been thoroughly investigated by the Forest Products Laboratory, though tests are under way.

The practice of installing insulation in existing buildings, some of which have been built for many years, is becoming general, adding both to summer and winter comfort of the occupants. The occurrence of moisture or condensation in these houses after insulation is uncommon, largely because such houses are not so tight as new ones, windows fit less snugly and probably have no weather strips. Under such conditions the normal indoor humidity is low. Occasionally, however, these older homes will also show evidence of moisture accumulation and generally when the occupant has made an effort to increase the humidity above normal. Some

of the companies that insulate existing houses take off a portion of the outer wall covering and cut a large number of openings in the sheathing through which the insulation is blown. The outer covering is replaced without filling the holes in the sheathing. These openings allow more or less ventilation and are perhaps helpful in allowing vapor to escape outward. Some companies include some form of attic or roof ventilation as a part of their contract.

Positive protection for existing buildings that have a moisture problem or where it is proposed to install winter air conditioning may require some type of barrier on the interior face of exterior walls and on the ceilings below the roof. Ordinary paints of the flat wall, or lead and oil types do not seem to offer the resistance desired, but two coats of aluminum paint, particularly on smooth plaster, appear to offer reasonably good resistance and permit almost any subsequent method of decoration desired.

The conditions that cause condensation in side walls also occur in attics or under roofs, modified more or less by any ventilation that may be provided or that may occur naturally. Roof condensation is observed or reported far more frequently than side wall condensation, since it is more in evidence. For example, in a pitched roof house condensation may develop on the roof sheathing during a severe cold spell, forming as frost or ice. During subsequent mild weather or under a bright sun the ice melts and water works back through the plaster and spots the ceiling.

The principles that apply to side wall protection also apply to attics, modified somewhat by the type of roof. In new construction it is easy to apply vapor barriers the same as for walls. However, many kinds of roof materials are highly vapor resistant and any vapor passing through the barrier, or otherwise reaching the space below the roof cannot escape readily through the roof covering. With pitched roofs, ventilation through louvered openings, windows, or other means will usually take care of the situation. With flat roofs and hip roofs, and where the ceilings are bisected by roof rafters it is often difficult to provide adequate ventilation. Unless ventilation can be provided for such types of construction, it is not safe to carry high winter humidities.

The question sometimes arises as to the possibility of summer cooling causing condensation in walls. This is very unlikely because the inside temperatures are seldom more than 15F below outside temperatures so that the possibility of condensation would only occur during periods of extremely high humidity outside. Such a condition would be of rather short duration and would be unimportant.

General Recommendations

For all new houses especially north of the Ohio River, it is recommended that a suitable vapor barrier be installed on the interior of all exposed walls and in the ceiling below the attic and that some form of attic ventilation also be provided. Further, that any sheathing paper used should be water resistant, but permeable to vapor. The protection afforded will also prevent condensation that might otherwise develop during the construction period, particularly if the house is plastered during cold weather.

For existing houses having no vapor barriers maintain humidities at such point that condensation will not develop in walls and attics. Since conditions in walls cannot be readily determined, the attic, if tight and without ventilation, may be used for observation. In general, the safe humidity inside in relation to outside temperature will correspond roughly with the values given in Fig. 1. To maintain higher humidities safely some form of vapor barrier can be applied to the exposed walls and ceilings, such as two coats of aluminum paint. While not offering as much resistance as the more effective barrier this method should mean that humidities of about 30% could be maintained in normal winter weather having short periods of zero weather.

The suggestions offered are based upon tests made at the Forest Products Laboratory, part of which are still under way, combined with observation and experience in occupied houses. As further information becomes available additional recommendations and modifications of the present ones will be released.

Heat Wave Causes High Death Rate, Detroit Study Shows

DEATHS were considerably hastened by a heat wave that occurred in July, 1936, in Detroit, according to an analysis of weather and mortality statistics in the *Bulletin of the American Meteorological Society* by Clarence J. Root of the U. S. Weather Bureau at Detroit. In that month the maximum temperature exceeded 100F on seven consecutive days. In the previous history of the Detroit Weather Bureau, starting with 1871, 100F or higher has occurred only seven times, but in 1936 this number was equaled in a single week.

WEATHER AND DEATHS IN DETROIT, JULY, 1936

Date	Max. D.B. Temp., F	Number of Hours Temp. Exceeded			No. Deaths From Heat
		90 D.B.	100 D.B.	68 W.B.	
7.....	89	0	0	0	0
8.....	104	11	5	7	2
9.....	102	12	7	1	8
10.....	102	12	6	4	18
11.....	101	12	1	6	35
12.....	100	12	1	8	67
13.....	102	12	4	4	70
14.....	104	7	4	1	67
15.....	87	0	0	0	17
16.....	90	0	0	0	6

The unprecedented character of this hot wave is indicated by the fact that whereas the average number of heat deaths per year from 1920 to 1935 was about 17 (ranging from zero in 1920 to 40 in 1931) in 1936 there were 304 heat deaths up to July 23. The accompanying table summarizes the weather and the mortality statistics during this heat wave.

A Model Gas-Burning System Heats Utility Service Building

WHEN the consolidated Edison Company of New York, Inc., undertook to convert the heating plant of its Flushing Central Service and Garage Building from coal to gas the company decided to make it a model installation. It was hoped that this installation, the largest gas heating job in the New York metropolitan area, would show the way for converting similar commercial heating boilers. Because it was to serve as an example for future jobs, considerable thought was put into the design and several new features were incorporated.

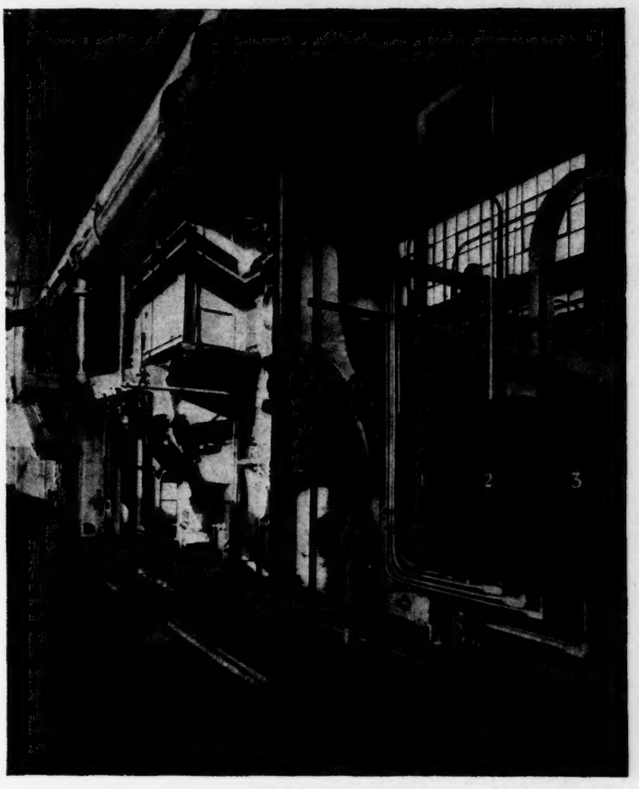
Before a decision was reached as to the kind of equipment which would be used on this job, a careful review of present conversion burner practice on large boilers was made. It was decided that this job, being a model installation, should be quiet in operation, it should be dependable for entirely automatic control and it should be as near foolproof as possible. It was decided that the best means of obtaining this objective was to use low-pressure ribbon burners to burn vertically in the firebox, and a separate motor-operated valve for each of seven sections of burner in the two 160-hp. boilers and for each of nine sections of burner in the 240-hp. boiler. Thus a flow of not more than approximately 2,500 cu. ft. of gas per hour is controlled by any one motor valve. Since these valves open in sequence, there is ample time for the chimney to establish draft before the burners come up to full rating. There is also an absence of sudden increase in demand on the gas supply, which is desirable.

The installation has performed in a very satisfactory manner and in the opinion of the owners well justifies the rather intricate design of the controlled system and the somewhat higher installation cost than would have resulted from some other design.

The heating plant consists of three low-pressure, fire-tube steel boilers, one with a rating of 240 hp. and the other two with a rating of 160 hp. each. These boilers furnish steam at 0 to 5 lb. pressure to the heating system for the rambling three-story structure which houses offices, shops, and garages of the utility. The heating surface in this building consists of cast iron radiators, pipe coils and unit heaters with a total equivalent radiator surface of approximately 48,000 sq. ft.

The changeover from bituminous coal to 540 B.t.u. manufactured gas was started late last fall and was made one boiler at a time without interrupting the operation of the plant.

Gas was available at 35 to 50 lb. per sq. in. pressure from a nearby 12-in. high-pressure main which was laid to supply the World's Fair. A 3-in. service pipe was run from this main to the boiler room. While the gas could have been burned at a pressure of 5 to 10 lb. per sq. in. it would have resulted in a noisy installation. Therefore, the gas pressure is reduced to approximately 3½ in. of water before being burned. This reduction is made by a standard district regulator and a bypass is



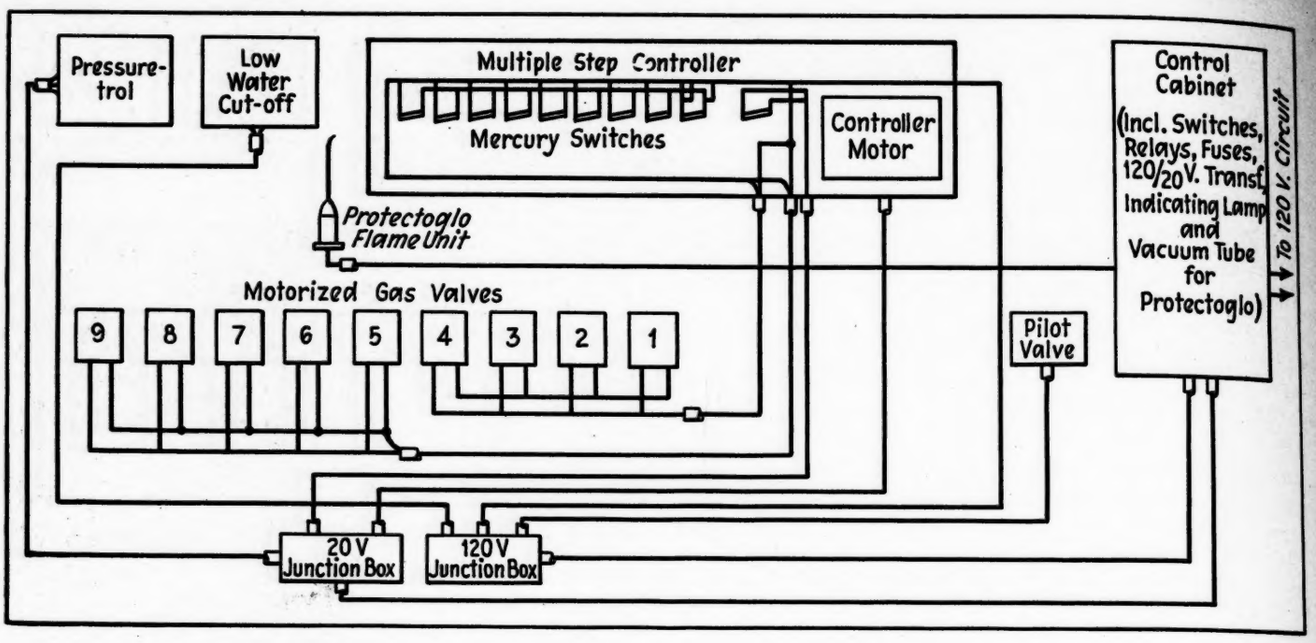
Layout of piping in the boiler room of the Flushing Central Service and Garage Building, Consolidated Edison Company of New York, Inc.

provided so that there will be no interruption of gas service in the event that the regulator must be shut down for adjustment or repairs.

Two lines lead from the reducing valve to the boilers, one carrying the gas for the pilot flames and the other the gas for the burners. The gas for the pilots and burners are metered separately. Because of the large consumption of the burners, 55,000 cu. ft. per hr. at a maximum, a positive displacement rotary meter was employed for the main supply.

From this meter the gas is carried to an overhead intake manifold located in front of the boilers. The gas is then piped to the burner manifold which is on the floor in front of each boiler. A battery of seven auxiliary manifolds leads from the burner manifold to the gas burner sets. On each one of these is a standard stall type motor valve for controlling the flow of gas to the burner fed from the manifold.

The gas is burned by ribbon type atmospheric burners capable of maximum turn-down without back-flashing. The burners are constructed of corrugated nickel-chromium alloy steel ribbons assembled in a cast iron burner head. These ribbons act as a screen to prevent flash back of the gas flame and burning within the burners. This type of burner has often been used in industrial work but this is one of the first applications in heating boilers.



Wiring diagrams for one boiler; this is typical of the diagram for other boilers.

The primary air to the burner is fixed on the inspirator and no adjustment is possible. The rate of gas flow to each set of burners is fixed by an orifice installed in the inspirator. All of the secondary air is taken in through the front of the boiler.

To provide a constant draft for the burners an automatic draft stabilizer was installed at the time the changeover was made.

When the boiler is started the seven sets of burners are brought into operation one at a time by a step control to effect quiet and smooth operation and to permit draft to be established before the burners reach full rating. When one burner set is brought on at a time the draft is gradually built up and there is no danger of excessive pressure in the combustion chamber. The step control operates to bring all burners on in about four minutes. This control also shuts off the burners one at a time when the boiler is shut down.

To insure rapid and easy ignition seven pilot flames are located throughout the boiler and one emergency pilot flame at the front of the boiler. A solenoid valve in the pilot gas pipe controls the flow of gas to the pilots.

The safety pilots are of the flame conductivity type. The safety pilot flame in each boiler passes over a metal electrode of a safety control system. When the system is operating correctly, a minute electric current will flow from this element through the gas flame and back to the control box. Here a radio type tube amplifies the current sufficiently to operate a relay. This relay in turn controls the seven motor valves and the pilot solenoid valve.

In case of flame failure the relay will cause the seven motor valves on the burner manifold and the pilot solenoid valve to close, shutting off all gas to the boiler.

Also in the case of current failure all valves will close and shut down the boiler. A manually-operated lever on each motor-operated valve enables the boiler to operate under manual control under such conditions.

While the boiler is in operation the burners are controlled by the steam pressure acting through a potentiometer resistance control which determines the number of burners which will operate. This action takes place through a step control which causes the valves to close in sequence as the pressure increases. The burners come on in reverse order as the pressure decreases.

A low water cutoff is connected to the control system and shuts off all motor valves at once when the water reaches a dangerous level. When the water returns to the proper level the step control brings the burners on in the proper sequence in about four minutes.

All control equipment for each boiler which does not have to be on the boiler or burners is located in a separate control box at the side of the boilers. This makes the equipment readily accessible for repairs and adjustments. A red bulb on each box is used to indicate the boilers which are operating correctly.

Hot Well Water Heats Buildings

HARNESSING natural hot water wells to heat buildings is something new in Oregon. At Klamath Falls in that state there has been recently pumped for the purpose water piping hot from a hole in the ground. Such hot well water serves to heat the new gymnasium and shop building at the Klamath Union High School and provide for the school children in a comfortable manner. The water was taken from a well recently pumped on the edge of Modoc Field—the adjacent high school athletic grounds. In similar fashion hot water wells are heating several other houses, apartment and business buildings of the city, and the piping of the natural flow of subterranean hot water for heating other buildings is expected to be further developed.

Summer Wet Bulb and Simultaneous Dry Bulb and Dewpoint Temperatures

Studies of wet bulb temperatures intended to supply the air conditioning engineer with data badly needed in design work have always been difficult for two reasons: first, the weather bureau reports which are generally available usually give only the dry bulb and relative humidity readings, making a conversion necessary for each reading if wet bulb temperatures are desired; second, in practically all cases relative humidity readings are taken only three times a day—morning, noon, and late afternoon.

Scope of the Study

There is a reasonable amount of evidence showing that although the maximum dry bulb temperatures most frequently occur in the afternoon, the local noon wet bulb is close to that existing later that same afternoon. With this in mind, it would seem that a study of noon wet bulb temperatures should yield data which would be essentially like those from a study of wet bulbs during all hours so far as maximum conditions are concerned.

The accompanying data, then, are entirely from local noon readings, covering the years 1932 to 1937, inclusive—a six-year period. After a preliminary examination of the data, it was decided that the study could be confined to the two hottest months—July and August—and still yield results which would differ only very slightly from those found by a study covering all summer months.

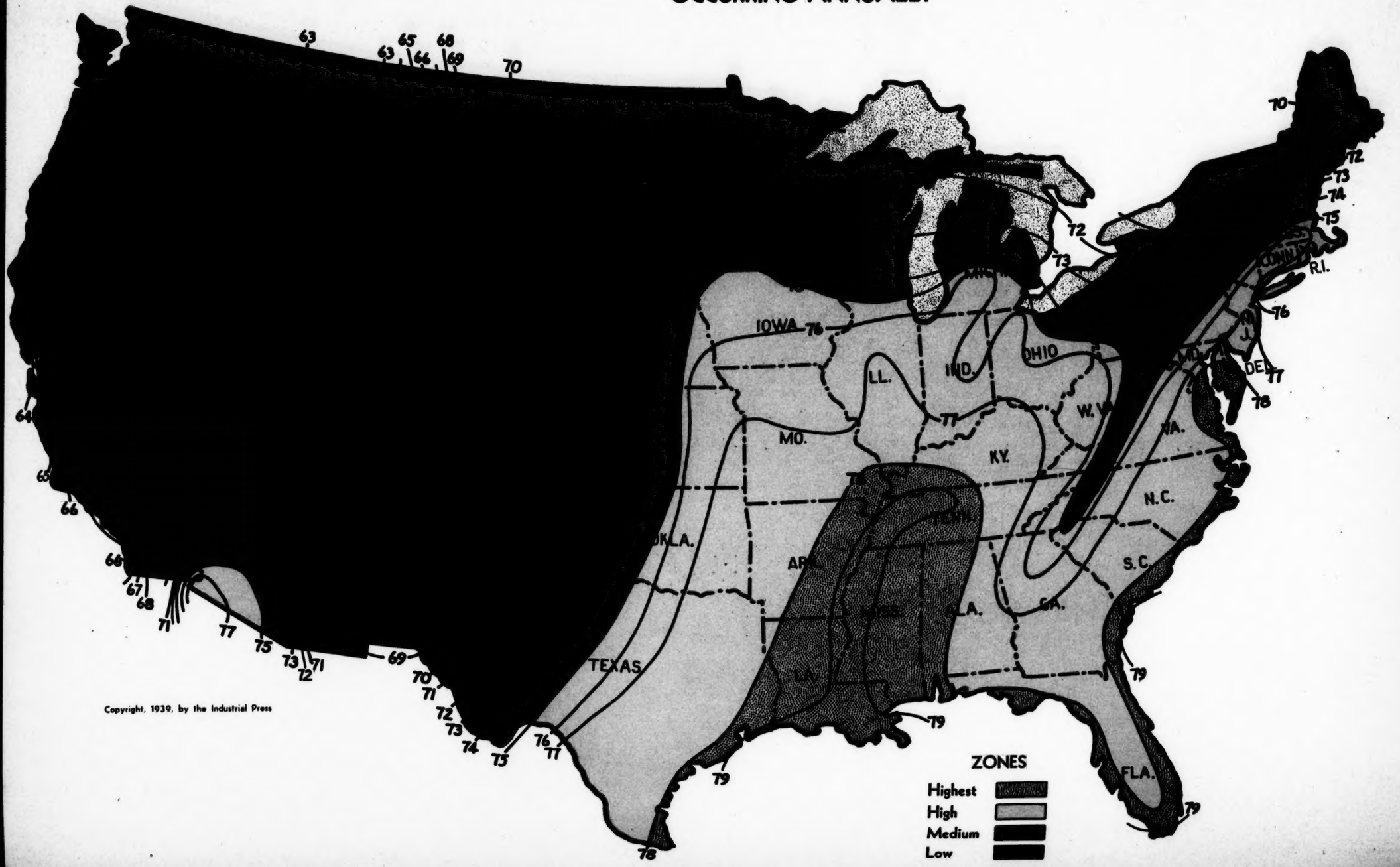
Data Shown in the Table

Designers are concerned not only with maximum or near maximum wet bulb temperatures but with the simultaneous dry bulb also. For this reason the table shows not only maximum wet bulbs classified in two different groups, but the simultaneous dry bulb and corresponding dewpoint as well.

The table is divided into two parts. The first part shows, in the first column, the maximum wet bulb found from a study of the noon wet bulb temperature for each day of all the Julys and Augusts of the six-year period. The second and third columns give, respectively, the simultaneous dry bulb and dewpoint at that maximum wet bulb. The second part of the table shows, in the fourth column, the highest wet bulb which occurred at least once during each year of the six-year period. More often than not this temperature occurred fairly frequently in some years; each of the readings was examined and the last two columns of the table show respectively the maximum dry

Text continues following Map and Table.

HIGHEST NOON WET BULB TEMPERATURE OCCURRING ANNUALLY



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Tabular Data for 55 Cities

MAXIMUM WET BULB TEMPERATURES AND SIMULTANEOUS DRY BULB AND DEWPOINT TEMPERATURES AT NOON DURING JULY AND AUGUST IN A SIX-YEAR PERIOD

City	Temperatures at Time of Maximum Wet Bulb			Temperatures at Time of Maximum Wet Bulb of Annual Occurrence		
	Max. Wet Bulb, F	Max. Simultaneous Dry Bulb, F	Simultaneous Dewpoint, F	Max. Wet Bulb Occurring At Least Once Annually, F	Max. Simultaneous Dry Bulb, F	Simultaneous Dewpoint, F
Albany, N. Y.	80	90	76	72	89	64
Amarillo, Tex.	74	88	69	70	95	59
Atlanta, Ga.	79	92	74	76	96	68
Baltimore, Md.	80	92	76	77	104	65
Birmingham, Ala.	80	95	75	78	99	70
Bismarck, N. Dak.	76	90	71	73	98	62
Boise, Idaho	72	93	63	66	101	44
Boston, Mass.	82	93	78	76	90	70
Buffalo, N. Y.	77	87	73	72	84	67
Charlotte, N. C.	80	95	75	77	95	70
Chicago, Ill.	80	91	76	76	103	64
Cincinnati, Ohio	85	92	83	77	94	70
Cleveland, Ohio	80	84	79	74	91	67
Columbus, Ohio	79	94	74	76	100	66
Denver, Colo.	65	92	50	63	93	45
Des Moines, Iowa	80	95	75	76	100	66
Detroit, Mich.	81	91	78	75	102	63
Duluth, Minn.	83	88	81	72	87	65
El Paso, Tex.	70	96	58	69	97	56
Ft. Wayne, Ind.	78	98	70	74	100	62
Ft. Worth, Tex.	80	99	73	77	99	68
Grand Rapids, Mich.	79	92	74	76	104	64
Houston, Tex.	79	94	73	78	95	71
Indianapolis, Ind.	79	91	75	76	102	65
Jacksonville, Fla.	82	98	76	78	94	72
Kansas City, Mo.	80	98	74	77	105	65
Lincoln, Neb.	79	93	74	76	100	66
Little Rock, Ark.	82	100	76	78	100	69
Los Angeles, Calif.	74	96	64	68	91	55
Memphis, Tenn.	84	92	82	79	95	73
Milwaukee, Wis	79	94	74	74	99	62
Minneapolis, Minn.	80	92	76	74	103	60
Nashville, Tenn.	81	97	75	79	97	72
New Orleans, La.	81	94	76	79	95	73
New York, N. Y.	81	93	77	76	85	72
Norfolk, Va.	82	90	79	78	94	72
Oklahoma City, Okla.	80	90	77	76	110	60
Omaha, Neb.	81	97	75	76	105	63
Peoria, Ill.	82	94	78	78	109	65
Philadelphia, Pa.	80	95	74	77	100	67
Pittsburgh, Pa.	78	95	72	75	98	65
Portland, Oreg.	72	92	62	66	88	52
Reno, Nev.	66	94	51	62	99	36
Richmond, Va.	80	97	74	78	94	72
St. Louis, Mo.	82	90	79	77	99	70
Salt Lake City, Utah	69	97	56	66	97	49
San Diego, Calif.	74	83	70	66	77	60
San Francisco, Calif.*	69	88	59	64	86	49
Savannah, Ga.	85	92	83	79	96	72
Seattle, Wash.	68	84	59	63	80	52
Spokane, Wash.	68	93	55	65	97	44
Tampa, Fla.	80	94	75	78	92	73
Toledo, Ohio	78	90	74	76	97	67
Washington, D. C.	79	94	73	78	92	73
Wichita, Kan.x	78	93	72	74	102	61

*The two hottest months in San Francisco are September and October; consequently for this city the data are for those months and not for July and August.

xData were not available for Sundays for this city, so that the data are from week-day readings only.

bulb of those accompanying the given wet bulb, and the simultaneous dewpoint.

Table Shows Annual Maximum

The first part of the table, therefore, while it does not show the absolute maximum wet bulb, does show a six-year or reasonable maximum wet bulb, together with the dry bulb and dewpoint experienced simultaneously. The second part shows what might be termed an

annual maximum wet bulb—one that should be experienced at least once every year. It also shows the highest simultaneous dry bulb and corresponding dewpoint.

Wet Bulb Design Temperature

The only rational method of setting the design wet bulb temperature for comfort cooling in any locality is by an economic study taking into account all cost factors. Such a method is too laborious to be warranted in most instances and some empirical rule of procedure has to be set up. It is believed that at the low annual load factor at which summer comfort cooling equipment generally operates, no design temperature is justified which would not reasonably result in operating the equipment at full load at least once each year. A design based on the wet bulb figures given in the forth column of the table (Maximum Wet Bulb Temperature Occurring at Least Once Annually) would bring about such a situation. These figures, therefore, represent a maximum design figure which should probably not be exceeded.

What the Map Shows

The map is a plot of the data in the fourth column of figures in the table, with the isotherms following, in a general way, a plot of average maximum wet bulbs, data for which were available for a much larger number of stations and which were plotted for use as a guide. The map is divided into four zones as follows: Highest, where the annual maximum wet bulb is over 78F; High, where this wet bulb is between 75F and 78F; Medium, 72F to 75F, and Low, wet bulbs below 72F.

The highest annual wet bulbs are experienced in the lower Mississippi Valley and along the Gulf coast, while low wet bulbs prevail over all the Western half of the country.

Points to be Noted

Points to be emphasized in interpreting the data are: (1) the figures are based on readings at noon, local standard time; (2) they cover every day of July and August during a six-year period, with two exceptions as noted in the footnotes to the table; and (3) when converting the original data (dry bulbs and relative humidities) to wet bulbs, the barometric pressure was taken into account.

Miami Building Completely Dieselized†

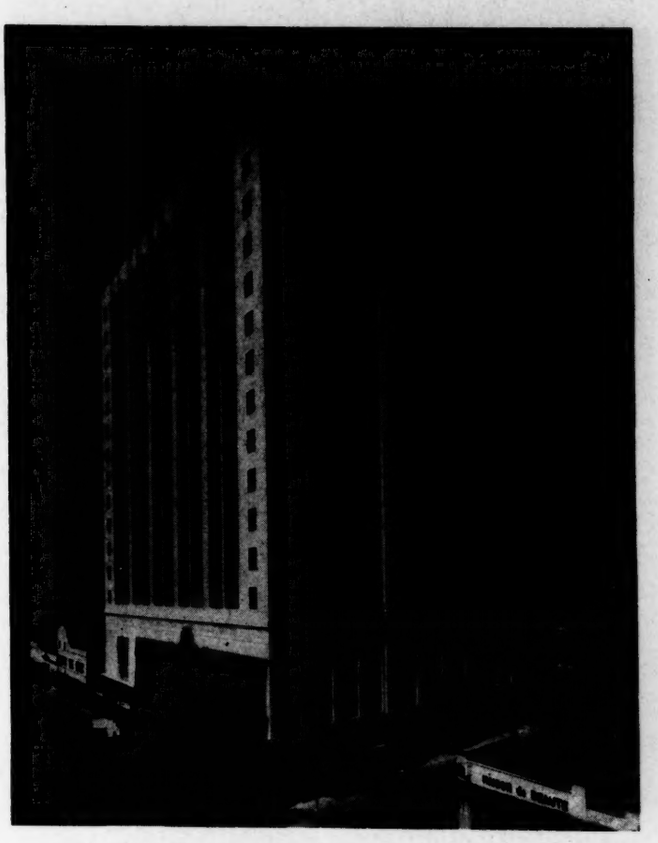
A NEW chapter in diesel progress was opened last month when the three 1050-hp., 16 cylinder, two-cycle diesels went on the line in the air conditioned 17-story Alfred I. duPont Building in Miami. This is the largest office building ever to depend entirely for all its light and power requirements on a diesel power plant and is said to be the first large office building combining air conditioning and dieselization.

This new building is air conditioned from top to bottom, including all its stores, banking rooms, and offices. All of the power requirements of the building, including air conditioning, are taken care of by the diesel power plant.

The power plant consists of three 16-cylinder, two-cycle diesels rated at 1050 hp. at 600 r.p.m. An auxiliary engine takes over the night and Sunday load and is an eight-cylinder four-cycle diesel, rated 225 hp. at 1200 r.p.m. One of the most interesting points in connection with the installation considering the size of the engines is that all four units are electrically started.

The main fuel oil storage tanks consist of two 3000-gal. units buried in the areaway. A transfer pump takes the fuel from the main storage tanks for the day tank for each engine; from the day tank the fuel passes through a duplex fuel oil filter, through a small filter in the fuel oil manifold, then to the unit injectors on each cylinder, in which is also located a small edged-type filter—thus insuring clean fuel to each injector.

The engine cooling system is of the closed-type with an expansion tank for make-up. Three radiator type heat exchangers are installed in connection with each engine; one handles the lube oil for each engine, the second handles the domestic water, and the third handles the engine water. Flow in one system is from the cooling tower through the lube oil and engine water exchangers back to the tower; in the other system flow is from the city water supply through the second heat exchanger, and then to the domestic water heater for the building. In other words, the heat from the jacket water is used to boost the temperature of the domestic water heater supply, thereby saving an estimated average of a million B.t.u. per hour. The cooling tower of 2400 gal. capacity, with incoming water at 102.5F, outgoing water at 90F with wet bulb of 79F, is located on the third floor of the garage and answers a dual purpose—that of cooling the water from the heat exchangers and also that from the air conditioning equipment. The supply to and from the cooling tower is thermostatically-controlled, maintaining an average outlet from the engines of 140F and also maintaining a good heat balance throughout the plant.



The fully air conditioned Alfred I. duPont Building in Miami, Florida.

The entire engine room is soundproofed by means of a 2½-in. blanket of soundproofing attached to the walls and the ceiling, over which is laid perforated transite blocks. All air entering the engine room is filtered both before and after leaving the blower which is located on the balcony. Each main engine is equipped with two large air intake silencers, as can be seen in the illustrations. No air is recirculated within the engine room, as the air not utilized by the engines for combustion is exhausted by means of an exhaust fan located at the rear of the engine room.

Marsh and Saxelby, Jacksonville, and Messena & duPont, Wilmington, Del., were the architects; Miller Electric Company was the consulting engineer on the power plant; George A. Fuller Construction Company, New York, was the general contractor.

†Information and photographs in this article presented through the courtesy of Rex Wadman, editor, *Diesel Progress*.

The power plant consisting of three 16-cylinder and one 8-cylinder diesels.

New Developments in Welding Pipe Fittings

By E. HALL TAYLOR†

In this article, abstracted from a paper presented by the author before the 39th annual convention of the International Acetylene Association, at Houston, March 8-10, Mr. Taylor reviews recent progress in design of welding fittings and in installation technique.

NEW developments in welding fittings have come about so gradually that most users are not aware of the type changes and of the improvements in fittings that are now available.

Of first importance from the user's standpoint is the new Proposed Standard for Welding Fittings. This new standard covers the overall dimensions of the fittings in elbows, tees, caps, reducers, return bends, and lap joint stub ends. It also covers the pressure ratings, size, marking, material, metal thickness, tolerance and the welding bevel. Engineering departments can now, with these standards established, lay out pipe lines with the knowledge that the fittings are now making changes to conform to the new proposed dimensions.‡

The angle of the bevel for butt welding has finally been agreed upon in this new standard. The bevel formerly used was 45° and the new bevel is 37½°. This bevel has been in use in pipe line work for some time. As fast as changes can be made, the 37½° bevel will be adopted on welding fittings. The narrow groove formed by this bevel has the advantages of requiring less weld metal, thus saving time and material.

Welding small diameter pipe has always presented a problem in lining up and in welding. The wall thickness of pipe 2 in. and under is of course comparatively thin. When this is bevelled for welding, the narrow bevel is not easy to line up with the pipe, and welding the thin wall requires care to avoid burning through. The development of socket welding fittings several years ago solved these difficulties, but, it has only been recently that they have come into widespread use. It is easy to center pipe in a socket fitting as the pipe slips into the end of the fitting for a short distance. A fillet weld is made between the fitting and the pipe. There is no danger of burning through, as this weld is on the outside of the pipe. The strength of these fittings is such, that in many tests to destruction, the pipe has always failed before the fitting shows distress. Socket fittings are now produced by several manufacturers and their use should do much to increase the welding of pipe two inches and smaller.

New developments in welding methods have steadily improved weld quality and increased the speed of welding. This has done much to further the installation of welded piping systems. We can now safely say that the quality of welding today is such, that in every case, the welded joint is equal to or stronger than the pipe itself. We feel, that the same statement should hold true of welding fittings in order to give a full strength pipe line throughout. In order to accomplish this, fittings should be reinforced at the points of greatest strain. Tests to destruction have been conducted on many fittings in which the seamless pipe has burst before the fitting, showing how well this reinforcing has strengthened the fitting against deformation.

The reinforcing of branch connections attached to pipe by welding has assumed such importance that a committee has been formed by the American Standards Association to study this for addenda to the Code for Pressure Piping. Extensive tests are being run by the members of this committee to determine just what the strains are and what reinforcement is necessary when a hole is cut in a pipe for a branch connection.

We are all aware that welding is used today on practically every installation that requires high quality. However, there are many low-pressure installations where the user feels welding is too costly. Now the cost of welding a fitting into the line is not just the cost of making the weld—that is often the smallest part of the cost of making a joint. Often the largest part of this cost is that of making ready, laying out, cutting and fitting and lining up to get ready to weld. The first step is to insure the welding operator getting the right fitting for the job. This may seem a small item, but shop men know how much time can be wasted looking up tickets and tags and checking dimension tables, trying to identify fittings from a stock pile full of various sizes and standards. To provide positive identifications, the size and standard of each fitting is stamped into the fitting along its side. Anyone without any knowledge of pipe standards can easily identify a fitting so stamped.

Given the right fitting, we next tackle the problem of lining it up. Fittings are machine beveled accurately so that there is no problem in their joining evenly against the pipe end. The real time lost is in trying to determine the angle at which the fitting should be turned so as to fit the next run of piping. An angle cannot be measured without some reference point to start from, so the center line of the fitting must first be determined. This takes time and is not the easiest thing to do on an irregularly shaped object like an elbow. Hence, the new development of marking center lines on elbows. These center lines are machine marked for accuracy. With these as reference points it is easy to determine any angle at which it is wished to place the elbow.

Lining up the welding fitting so that it is concentric with the pipe end is a problem that many have worked on. Various jigs and clamps have been made to do this; some of them are very helpful and time can often be saved by using them. In all cases, easy means of lining up are not available. A new fitting which lines itself up has now been developed with a centering ring as part of the fitting. This centering ring, forged in-

†Vice-President, Taylor Forge and Pipe Works, Chicago.

‡Copies of this new proposed standard can be obtained from The American Society of Mechanical Engineers, 29 West 39th St., New York.

tegral with the fitting, centers the elbow into the pipe, thus assuring accurate alignment instantly without any leveling or shimming. This ring will support the pipe end, holding it in readiness for welding, thus eliminating the need for extra supports. In addition to saving time in lining up, this ring has been found to improve the strength of the joint weld by assuring complete penetration. This centering lip acts as a backing up ring for the weld metal against this ring without fear of burning through; thus the weld extends clear down to the bottom of the bevel, which is not always the case in some butt welds. The ring stops weld metal from flowing inside the pipe, thus preventing forming any projections or icicles to obstruct the flow. The ring is an integral part of the elbow, so there is no danger of its coming loose in the line. It is so small and fits so snugly to the pipe, there is no measurable friction loss.

We have only begun to see the developments in welding and in welding fittings. It is our hope that they will develop so rapidly and show such quality and economy that soon all pipe lines, large and small, will be welded.

Swiss Tile Stoves Publicized

TWO series of interesting and attractive pamphlets, one in French, the other in German, have been received by HEATING & VENTILATING from the Association of Manufacturers of Swiss Tile Stoves. These bulletins, prepared by H. Mall, illustrate the many different models of these stoves available for different uses and describe their arrangement and application.

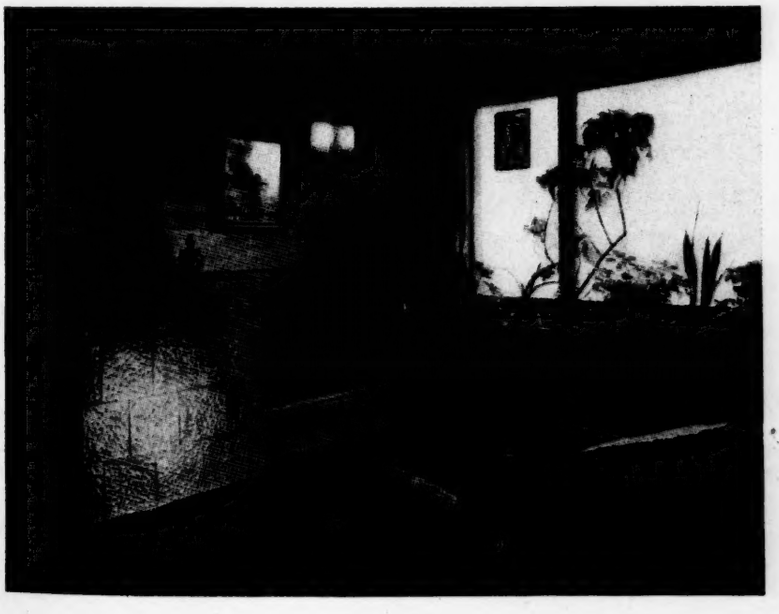
Tile stoves have been used for centuries in Europe and their application is well known, particularly in Germany and Switzerland. However, one of the functions of the pamphlets is to point out the use of these stoves in connection with central heating. Advantages claimed for central heating with these devices are said to be that they provide central heating, cooking, and food warming, all with a single device. An important feature of the tile stove is, of course, the fact that the tile as it grows warm emits a great part of its heat as radiant energy, and since there is a considerable mass of the tile, the stove holds the heat for a considerable period. When used for central heating the device is either of the type whereby warmed air is transmitted by ducts to other rooms or as is sometimes the case, a coil is inserted in the furnace of the stove and supplies radiators located throughout the house.

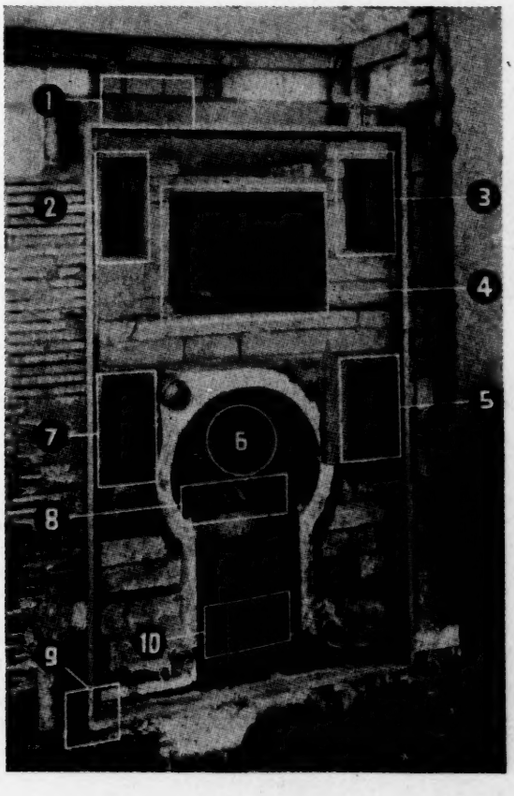
Fig. 2 shows a tile stove nearly completed and as seen from the kitchen side on removal of the front plate. The grate is shown at the bottom (10) on either side of which are shown the two return pipes for central heating. (8) shows the removable grate, to the upper left of which is the main supply outlet. On either side of the boiler furnace (6) is shown the passages through which the hot gases travel on their way to the flue. (4) is the opening for the cooking stove. When assembly reaches this stage the cover plate is put on the front and the whole stove encased in the tile.

Fig. 1 shows a smaller tile stove used for room heating only but has the additional feature that the unit is extended to form a comfortable and cozy seat.

The bulletins are published by the Verband Schweizerischer Kachelofen-Fabrikanten, with headquarters in Zurich, Switzerland. The association, which consists of 11 manufacturers, states that a tile stove will be displayed in the Swiss Pavilion at the forthcoming World's Fair in New York.

Fig. 1 (Below). A Swiss tile stove as used for room heating. Fig. 2 (Right). One type of Swiss tile stove, the assembly of which is nearly completed and as seen from the kitchen side before the front plate is applied.





When a Customer Goes Bankrupt

By CHARLES R. ROSENBERG, Jr.†

YOUR morning's mail will probably bring you the first word of it. The notice you'll receive will begin something like this: "In the District Court of the United States, In Bankruptcy. . . ." In formal legal language it will go on to say that one of your customers has been adjudicated a bankrupt and that at a time and place set forth in the notice there will be a first meeting of creditors for the purpose of electing a trustee and examining the bankrupt. The notice will be signed by a Referee in Bankruptcy, giving his name and address. Ordinarily, the meetings of creditors are held at the Referee's office.

The bankrupt owes you money, probably a balance due on an installation. That's why you get a notice of the meeting. The fact that he's in bankruptcy means that he is unable to pay his debts in full. If he has assets of any substantial value, you can get a percentage of the bill he owes you; the law calls that percentage a "dividend." But you won't get anything unless you do something about it. What to do?

First, get what information you can from the Referee's office. The Referee is an official of the United States District Court, whose function it is to preside in bankruptcy cases instead of a judge. In every bankruptcy there is filed with the Referee a set of "schedules" setting forth in detail the assets and liabilities of the bankrupt. The last page of the schedules is a summary of the assets and liabilities. As a creditor you have a right to examine the schedules.

If the summary shows that your bankrupt customer's assets are virtually trifling in comparison with the total of his debts, simple arithmetic makes it clear that you aren't going to get anything and that any further time or thought given to it will be wasted. Write off the account to profit and loss.

But suppose the schedules show considerable assets, enough perhaps to pay the creditors substantial dividends. In order to get your proper share, you are required to file a formal proof of the debt which the bankrupt owes you. To do this, get a printed form called "Proof of Claim," fill in this form to fit the particular case, take the affidavit provided for in the form, attach an itemized statement of your account with the bankrupt, and file the whole document with the Referee's office. Sounds technical, but it really isn't.

The form you can get from a legal stationer. The clerk in the Referee's office can probably tell you the nearest one and ordinarily will be willing to help you fill in the form correctly.

This legal "Proof of Claim" must be filed within six months after the date on which your customer was adjudicated a bankrupt, as shown by the Referee's records. If filed later than that, your claim is too late and cannot participate in any fund available for distribution among the creditors. Filing your Proof of Claim with the Referee protects you on any dividend ultimately payable to creditors and you don't have to do any more about it. Even where a dividend is payable, you won't hear anything about it for at least six months and possibly not for a year.

The first meeting for creditors mentioned in the notice sent to you by the Referee is held for the purpose of questioning the bankrupt about his affairs, particularly his assets, and electing a trustee. If you wish, you can take your completed Proof of Claim to this meeting and file it with the Referee at that time. This will entitle you as a creditor to ask questions of the bankrupt and to vote in the election of Trustee.

The Trustee in bankruptcy is an official elected by the majority of the creditors present at the meeting and charged with the duty of taking possession of the bankrupt's assets, liquidating them, and distributing the proceeds among the creditors. He is at all times under the supervision of the Court and subject in his actions to the provisions of law. Sometimes a receiver is appointed by the Referee before the first meeting of creditors. Usually, this is for the purpose of protecting the bankrupt's assets until the Trustee is elected. Thereupon the Receiver turns over the assets to the Trustee.

How much can you expect to get out of the bankruptcy? First thing out of the bankrupt's assets come the legal expenses of the bankruptcy proceedings, and, usually, his exemption as allowed him under the law of his own state. Whatever is left—if anything—goes to the creditors. Certain creditors are "preferred" in bankruptcy; that is, they are paid first. But the heating and ventilating contractor is not one of them. He is just an ordinary creditor who must take his chances on getting a dividend.

Sometimes it happens that a customer moves away and goes into bankruptcy in a distant place—too far for you to inquire into the thing in person. In that case, simply mail your Proof of Claim, with itemized copy of the account attached, to the Referee from whom you receive the bankruptcy notice. It would be wise to get a registered mail receipt just to have definite evidence that the Referee got your Proof of Claim within the six months' limit.

Do you need a lawyer? If it's just a case of filing a Proof of Claim a lawyer could of course draw up the Proof of Claim with due care for technical details, but he could not get you a larger dividend in the ordinary case. He could attend the meeting of creditors and vote for election of Trustee for you, provided you give him written power of attorney to do so. If you suspect the bankrupt of fraud and want to develop that possibility rather thoroughly at the meeting, better have a lawyer handle it for you.

Occasionally creditors in a bankruptcy receive letters from a lawyer inviting them to send him their Proofs of Claim together with power of attorney to represent them at the meeting of creditors. This sort of solicitation is in questionable taste, to say the least, for it invites the suspicion that the lawyer is probably much more interested in electing his hand-picked candidate as Trustee than in helping the creditors.

†Attorney-at-Law, Media, Pa.

The Flow of Air and Its Distribution Through Ducts

Part 3—Elbows and Miscellaneous Resistances

By J. R. ZWICKL†

Elbows

Resistance of Elbows: The pressure loss in elbows is partly due to friction, partly due to impact losses. If the radius R of the elbow center line is small compared to the diameter d, then the friction loss is low, but the impact loss very high. As the curvature ratio $\left(C = \frac{R}{d}\right)$ increases, friction increases, impact loss decreases. At about $R/d = 2$ the combined loss is a minimum.

It is customary to express the elbow loss as a multiple of the velocity head *(for the velocity in the elbow)* and as a function of the curvature ratio:

$$h'_L = e\left(\frac{v}{4000}\right)^2$$

where:

$$e = function\ of\left(\frac{R}{d}\right)$$

Another method is to replace the elbow with an equivalent length of pipe of the same diameter and figure the loss as *pipe friction:*

$$h'_L = f\left(\frac{l}{d}\right)\left(\frac{v}{4000}\right)^2 = fn\left(\frac{v}{4000}\right)^2$$

where $n = l/d$, the number of pipe diameters which give the equivalent elbow length. From these two equations it is evident that $e = fn$. With $f = 0.02 = 1/50$ we find $n = 50e$.

Table 5 gives for different values of C and r corresponding values of n and e for $f = 0.02$.

Whenever possible, the elbow should be made with a curvature ratio $R/d = 1.5$ (or 2 for high velocities). A larger R/d increases the elbow dimensions and thus its cost unnecessarily without any real benefit.

Since we express the elbow loss as $e = nf$ velocity heads we should know the velocity in the elbow. However, if we have determined the different d_x branch diameters by means of equation (28), then according to equation (30) the factor j_x gives the *velocity-head ratio* for the branch and main duct. Therefore, we can express the velocity-head for any branch duct (in which there is an elbow) as a multiple of the main-duct velocity head, which is known; we find:

$$h_x = \left(\frac{v_x}{4000}\right)^2 = j_x\left(\frac{v_1}{4000}\right)^2 = j_x h_1$$

and with this we finally arrive at the elbow loss as:

$$(h'_L)_x = e_x h_x = e_x (j_x h_1) \quad \ldots\ldots\ldots\ldots (31)$$

where e_x can be taken from Table 5 for the (R/d) value of the elbow No. x. It is customary to take $e = 0.2$ for round ducts and $e = 0.1$ for square ducts with an aspect ratio of $b = \frac{B}{H} \geq 1.5$ where B is the dimension in the radial direction of the elbow.

Turnblades: For narrow spaces it is often necessary to make the elbow as small as possible, which therefore means a small (R/d) value and consequently a large loss. Such loss can be greatly reduced by putting so-called turnblades into the rectangular elbow. They divide the elbow into several parallel sections each having a larger (R/d) value and consequently a smaller loss than the original elbow itself.

If R_i and R_o designate the inner (smaller) radius and the outer (larger) radius of an elbow, then $\frac{R_o}{R_i} = r$ is the *radius ratio* of the elbow. For every curvature ratio $\left(C = \frac{R}{d}\right)$ there is a certain radius-ratio $R_o/R_i = r$ according to:

$$r = \frac{2C + 1}{2C - 1}$$

The turnblades are laid out so that each elbow-element has the same radius-ratio r (see Fig. 2):

TABLE 5. LOSSES IN ELBOWS
(Based on values from curves in *Fan Engineering*)

Curvature Ratio, C	Radius Ratio, r	Round Elbow		Square Elbow	
		Loss, e, in Per Cent of Velocity Head	Equivalent Pipe Diameters, n	Loss, e, in Per Cent of Velocity Head	Equivalent Pipe Diameters, n
0.5	∞	0.74	37.0	0.95	47.5
0.6	11	0.52	26.0	0.52	26.0
0.7	6	0.42	21.0	0.37	18.5
0.8	4.33	0.35	17.5	0.28	14.0
0.9	3.50	0.30	15.0	0.22	11.0
1.0	3.00	0.26	13.0	0.18	9.0
1.2	2.43	0.205	10.25	0.12	6.0
1.4	2.11	0.175	8.75	0.092	4.6
1.5	2.00	0.17	8.5	0.085	4.25
1.6	1.91	0.16	8.0	0.080	4.0
1.8	1.77	0.15	7.5	0.075	3.75
2.0	1.66	0.145	7.25	0.075	3.75

$C = \frac{R}{d}$ = *Curvature ratio*

$r = \frac{R_o}{R_i}$ = *Radius ratio*

R_o = *Outer radius of elbow*

R_i = *Inner radius of elbow*

f = *.02 coefficient of friction*

$n = \frac{e}{f}$ = *equivalent length in pipe diameters*

†Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.

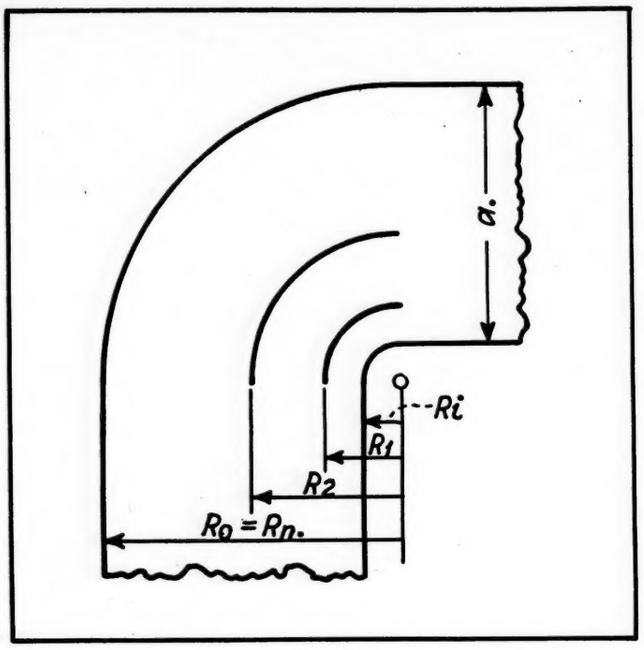


Fig. 2.

$$r = (R_1/R_i) = R_2/R_1 = \ldots . R_n/R_{n-1}$$

where R_1, R_2, . . . R_n are the radii for each succeeding turnblade. Obviously $R_o = R_n = (R_i + a)$. Furthermore:

$R_1 = rR_i$

$R_2 = rR_1 = r^2R_i$ etc. and finally

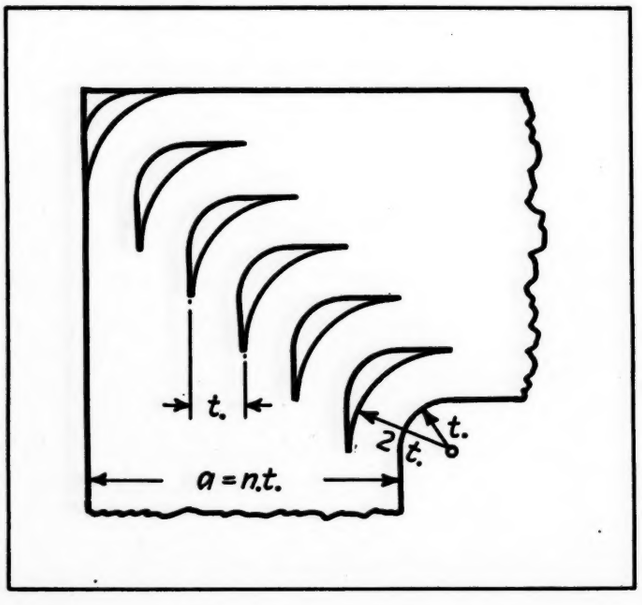
$R_n = rR_{n-1} = r^nR_i = (a + R_i) = R_o$

From this it follows that:

$$R_i = \frac{a}{(r^n - 1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (32)$$

where R_i is the inside radius of the duct, a is the width of the duct in the radial direction, r is the radius ratio and n is the number of sections into which the width a is divided by the turnblades.

We can either select R_i and figure r for a chosen n or —what is much simpler—we select r and n and figure R_i. For the generally used curvature ratio $R/d = c = 1.5$ the value of $r = 2$ and with this the above equation simplifies into:



$$R_i = \frac{a}{(2^n - 1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (32a)$$

If the elbow is so subdivided by turnblades, its resistance is fixed by the radius ratio of the elbow elements.

Another way to make the turnblades is to make them all equal with the same radius ratio. If we divide the width a into n sections, then $t = a/n$ is the width of the elbow element. For the radius ratio $r = 2$, we find $R_i = t$ and $R_o = 2t$ for each turnblade (See Fig. 3). With this type of turnblade, the smallest elbow is possible without excessive resistance.

Miscellaneous Resistances or Losses

Losses caused by a plenum chamber: (= h'_p): Quite often the air from the fan is not blown into a so-called main duct, from which the branch ducts take off, but first into a plenum chamber; then the major branch ducts start from this plenum chamber.

Unless the duct which leads from the fan outlet to the plenum chamber diverges at a rather small angle, so as to reduce the air velocity gradually and transform the velocity back into static pressure, the velocity head — corresponding to the fan outlet velocity — is practically lost. The kinetic energy of the air stream is killed in the plenum chamber by eddies and turns into heat. Thus, when the air starts from the chamber into the ducts, it must be re-accelerated anew from practically zero velocity to the velocity in the duct. The pressure (or head) consumed for this re-acceleration is taken from the available static head; consequently, it must be produced by the fan as available static head, just as if it would be needed to drive the air stream through a resistance of like magnitude.

In exhaust systems especially, quite often the branch ducts lead first into a plenum chamber from which the air then goes to the fan; here, too, the velocity head of the air coming from the branches is mostly lost and the air must be speeded up once more by the fan.

The same holds true for any chamber in between, where the air velocity is lost and must be created again.

Quite logically, therefore, we can classify a plenum chamber as a resistance which causes a loss of head

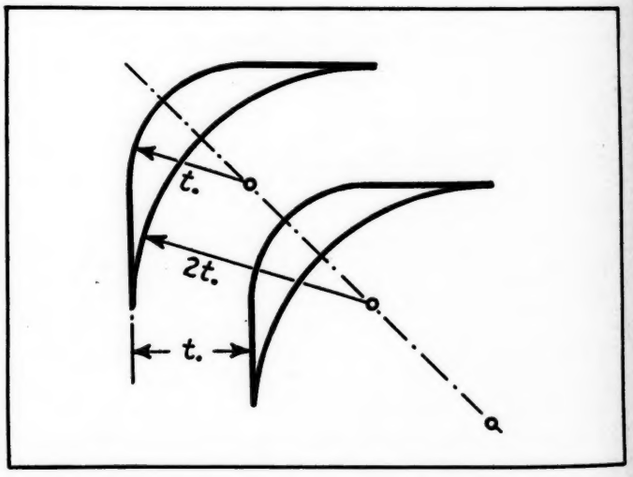


Fig. 3. Details of layout of turnblades where all are made equal with the same radius ratio. (Left) the location of the blades in the elbow. (Above) enlargement to show details of blade radii.

equal to the velocity head for the outgoing air velocity in that branch duct having greatest overall resistance.

It might be cheaper to build a duct system with a plenum chamber than to lead each branch duct gradually into a main branch duct for saving the velocity head, but it certainly would be costlier to operate it.

Entrance Loss: (h'_i). Whenever air enters from a pressure chamber or from the outside into a duct, this is accompanied with a certain loss of head. This loss is caused by the fact that whenever air passes through an opening with sharp edges or corners, the cross-section of the air-stream contracts to less than that of the duct or the opening. The velocity is the highest in this smallest cross section of the stream (called *vena contracta);* from there on it slows down again; the cross section of the air-stream increases until it fills the whole area of the duct. During this process there takes place a change from velocity head back into static head, a change which, however, is not 100% effective, thus causing a loss of head. The total pressure drop between the chamber and duct is:

$$h = (h_v + h'_i) = h_v (1 + c_r) \text{ with}$$

$$h_v = m\left(\frac{v}{1098}\right)^2 = \left(\frac{v}{4000}\right)^2 \left(m/m_o\right)$$

as the true velocity head for the velocity v in the duct beyond the entrance and $h'_i = c_r h_v$ as the (entrance) loss expressed as a multiple of this velocity head; c_r is called the *coefficient of resistance.*

If the entrance to the duct is widened out like a bell-shaped nozzle following the contours of the naturally contracting air stream, there is no entrance loss, since the final area of the duct is identical with the vena-contracta, beyond which there is no expanding of the air stream, and, consequently, there is no head loss except friction *($c_r = o$).*

If the duct stands vertical to the side wall of the chamber and is flush with the wall without protruding, then the entrance loss is about 50% of the velocity head in the duct *($c_r = .47$).*

If the duct walls converge like those of a funnel or hopper, c_r decreases and reaches a minimum of about 0.13, when the angle enclosed by the walls is around 11° to 15°. If the angle is increased beyond this value, c_r increases again. For an included angle of $\delta = 20°$ c_r is about 0.17 and for $\delta = 30°$ c_r is about 0.25. This latter value is commonly used in layout work. Naturally, this loss refers to the velocity head in the duct beyond this entrance. To insure proper air flow, the length of this converging entrance nozzle should be at least three times the smaller side of the duct.

If the walls of a straight duct protrude into the plenum chamber or into the outside, and form there a sharp edge, the entrance loss is almost one velocity head. Therefore such construction should be avoided. The loss may be reduced by opening up the duct to form a converging entrance nozzle, as shown above.

Converging and Diverging Ducts: When a duct converges, this means an increase in velocity and a drop in static pressure. This is usually accomplished without appreciable loss, unless the angle of convergence is too great, when shock losses will occur. Up to an included angle of 45° these losses are negligible.

If the duct diverges, its cross-sectional area increases and the velocity in it decreases. Consequently, there will be a conversion of velocity head into static head, which we call static regain. Such regain is possible only if the divergence is not so rapid that the air would lose its contact with the walls. If this happens, most of the kinetic energy of the air stream will be consumed by eddies and little if any static regain is possible.

TABLE 6. EFFICIENCY *(r)* OF THE STATIC-REGAIN IN DIVERGING DUCTS AND NOZZLES
(Based on data in *Fan Engineering*)

Included Angle δ, Deg.	Regain r%	s = Tang δ/2	Regain r%
2	90.0	.02	89.0
4	85.0	.04	83.0
6	80.5	.06	78.5
8	76.5	.08	74.0
10	72.7	.10	70.0
15	64.0	.15	60.5
20	55.7	.20	52.0
25	48.0	.25	44.0
30	40.7	.30	36.0
35	33.5	.35	29.0
40	26.5	.40	22.0
45	19.7	.45	16.0
50	13.0	.50	10.0
55	6.5	.55	3.5
60	0.	.58	0.

The regain can be expressed as:

$$h_r = r\,(h_1 - h_2) = r\left[\left(\frac{v_1}{4000}\right)^2 - \left(\frac{v_2}{4000}\right)^2\right] \quad \text{.....(33)}$$

where

$h_1 = \left(\frac{v_1}{4000}\right)^2$ is the velocity head for the smaller cross section of the duct and h_2 the same for the larger cross section; r is the coefficient of regain; its value depends on the angle of divergence (the included angle). Table 6 gives the value of r for different included angles. As can be seen, its value drops rapidly as the angle increases. For the commonly used angle of 15° (slope about 1/6), its value is only 0.64 (about 2/3).

This regained static head helps to drive the air against the resistances of the system. So it is obvious that the larger the regain the less static head has to be provided by the fan. Therefore, a loss of regain is a definite loss of head, which must be compensated by the fan in developing a larger static pressure.

The regain is utilized in exhaust systems, where the discharge from the fan is gradually slowed down through such a diverging duct in order to regain as much as possible of its discharge velocity head.

Resistance of Filters, Heaters, Coils, Grilles, and Kindred Equipment: ($= h'_E$). Data on the resistance of such equipment is furnished by the manufacturer. *It is usually given as a function of the face velocity and based on standard air density.*

The resistance of all such equipment varies linearly with the air density, assuming equal face velocities. Therefore, if the air density is not standard, because of higher or lower temperature or barometer, then we must correct the standard or apparent resistance for the true density according to equation (18) in order to get the true resistance h'_E which will be offered by the equipment under actual operating conditions.

The next installment will appear in next month's issue.

ABSTRACTS of Current Papers, Books and Pamphlets

Gas-Fired Winter Air Conditioning

In order to guide contractors, heating engineers, and architects and to assist homeowners in securing the best in gas winter air conditioning in the New York Metropolitan area, the Metropolitan Heating and Air Conditioning Council has prepared a set of recommended practices for the installation of gas winter air conditioning in new homes.†

The guide is divided into 11 main sections each dealing with a specific item, such as approval requirements, heating unit, installation of furnace and air ducts. In each one of these sections recommendations are made as to the proper procedure in sizing, selecting, or installing the equipment. For example, the section dealing with the heating unit discusses the method of determining the heat loss of the house, the selection of the correct size air conditioning unit, and capacity of fan and motor.

A complete list of the sections follows: Approval Required; The Heating Unit; Erection of Furnace; Installation of Furnace; Controls; Air Ducts; Registers and Grilles; Filters; Electric Connections; Balancing Systems; and General Notes.

The Guide Committee is careful to point out that the recommendations are intended only as a guide for proper and adequate installation of gas winter air conditioning systems for new houses and should not be construed as a code of minimum requirements. It is suggested that the code be used as a basis for specifications covering proposed systems so that competitive bids will be on a uniform and standard basis.

[*"Gasco Installation Guide," prepared by the Metropolitan Heating and Air Conditioning Council. Heavy paper cover, 8½ x 11 in., 6 pages. Price ten cents single copies, reduced prices on quantities. Available from American Gas Association, 420 Lexington Ave., New York.*]

•

Effect of Impingement Dust Sampling Instruments on the Dust Particles

Although there are many types of dust sampling apparatus available, those of the impingent type are the more commonly used in this country for routine dust surveys. The Greenburg-Smith impinger has been used extensively by the United States Public Health Service and thus has become an accepted standard for recording dust concentrations. Green, Bloomfield, Fehnel, Gurney, and other investigators have attempted to correlate the "counts" from other impingement type instruments with those of the Greenburg-Smith impinger. Except for Green the investigators apparently have not considered the possibility that the instruments themselves may fracture the dust particles and thus give higher "counts" than actually exist in the air. Green lists under the mechanism of formation of smaller dust particles "the application of shearing and tensile stresses causes disintegration (of the larger particles) by splitting or cracking along planes of weakness in the material."

To determine whether the Greenburg-Smith impinger did fracture dust particles a series of tests was made by the author. As a result of these tests he concludes that the impingement type of dust sampling apparatus fractures the larger dust particles and that dust counts made by an impingement type dust counter are erroneous as they always give a higher count than actually exists in the air sampled.

[*"Effect of Certain Impingement Dust Sampling Instruments on the Dust Particles," by E. L. Anderson and published in the Journal of Industrial Hygiene and Toxicology. Volume 21, No. 2, February, 1939, pages 39 to 45. Published by the Williams & Wilkins Co., Mt. Royal & Guilford Aves., Baltimore, Md. Price for single issues, 75 cents.*]

•

Prevention of Silicosis

Experiments have indicated that the addition of metallic aluminum powder to air which contains silicious dust may prevent silicosis. In tests conducted by the authors of this paper six rabbits were exposed to quartz dust for six months and at the end of that time all showed they had developed silicosis. On the other hand, seven rabbits exposed to quartz dust plus 1% metallic aluminum powder for the same period did not develop silicosis.

The practical application of metallic aluminum powder for the prevention of silicosis has been questioned by some, who claim that an explosive hazard would exist if aluminum dust were introduced into the atmosphere of a mine. Investigators have found that when two parts of silicious dust and one part of aluminum powder were used the mixture would barely ignite if blown through a flame. In the explosion chamber, using enough of this mixture to give five times the minimum explosion concentration of aluminum powder, no increase in pressure could be obtained on ignition. Obviously, it would be impossible to produce an explosive mixture in a mine with any such quantities as would be required for this purpose.

Experimental work has been in progress at the McIntyre mine for some time to determine various methods of applying metallic aluminum powder for the prevention of silicosis. Certain methods have been devised whereby an excellent dispersion of the powder can be obtained in the underground atmosphere. By using small quantities of aluminum powder, varying from 3 to 20 grams, dispersed in a dust cloud, reductions in solubility of 90% or better were obtained from dust samples taken 150 to 300 ft. from the face, following a drift round blast, having a volume of 8000 cu. ft. These investigations are still in progress and will be reported at a later date.

†The situation which led up to the preparation of this book is explained on page 58.

The authors conclude from their studies that metallic aluminum on being converted into hydrated alumina reduces the toxicity of quartz in tissues in three ways: (a) by flocculation; (b) by adsorbing silica from solution; but (c) chiefly by coating the quartz particle with an insoluble and impermeable coating.

No animals whose lungs on analysis contained 1% or more of metallic aluminum have shown any evidence of silicosis up to periods of seventeen and a half months, in contrast to well developed silicosis in the quartz control rabbits in seven months.

Aluminum dust for the prevention of silicosis should be of a particle size below 5 microns and grease-free.

It should be uniformly mixed in any inhaled dust and bear a definite percentage to this dust at all times.

To prevent silicosis aluminum dust may be inhaled daily independently of the silicious dust.

The aluminum dust must be sufficiently concentrated in the inhaled dust to provide a minimum concentration in the lung of 1% at all times.

The inhalation of aluminum dust in large quantities over long periods of time showed no effect on the general health of the animals and no evidence of toxicity or damage to tissues.

Aluminum dust in any concentration necessary to prevent silicosis has been shown to be hundreds of times below the explosive concentration of aluminum powder.

[*"The Prevention of Silicosis by Metallic Aluminum," by J. J. Denny, W. D. Robson, D. A. Irwin. Published in the Canadian Medical Association Journal, Vol. 40, No. 3, March, 1939, pages 213 to 228. Journal published by the Canadian Medical Association, 3640 University St., Montreal, Canada. Price for single issues, 75 cents.*]

●

Pape-Swift Boiler Reference Book

This is the sixth volume of a boiler reference book series which is designed to furnish information on the dimensions and ratings of both current and old model heating boilers. The 1939 edition, like all previous editions, lists data on boilers not described in other volumes of the series. The six volumes now list over 1000 models of more than 100 different companies.

A master index listing all of the boilers described in the six editions is also available. This index identifies boilers by name and model number.

[*"Pape-Swift Boiler Reference Book, 1939." Published by John S. Swift Co., Inc., 105 S. 9th St., St. Louis, Mo. Paper cover; 5½ x 8½ in.; 341 pages; price, $1, plus 10 cents for postage. Master Index for 1934 to 1939 Editions; price, 25 cents.*]

●

Determination of Atmospheric Impurities

A definite answer to the question, "How clean is the air where men work?" may be found through procedures given in this bulletin, which was prepared by the Preventive Engineering Committee of the Air Hygiene Foundation. The bulletin lists proved methods of collection, determination, and apparatus for checking 45 dangerous substances commonly found in industrial atmospheres, such as ammonia, arsenic dust, benzene, chromic acid, carbon dioxide, lead dust, and sulphur dioxide.

Two steps are involved in checking the air of a workplace; first, measurement of air currents, and, second, estimation of impurities. Resulting data can then be applied to the design of control equipment or to checking the results brought about by such equipment.

[*"Routine Sampling for Control of Atmospheric Impurities," prepared by Preventive Engineering Committee, Air Hygiene Foundation, 4400 Fifth Ave., Pittsburgh, Pa. Paper cover, 6 x 9 in., 19 pages.*]

BRIEF REVIEWS

PREFABRICATION. A recent pamphlet of the National Bureau of Standards series on building materials and structures is devoted to a study of the structural properties of a fabricated construction for walls and partitions. [*"Building Materials and Structures—Report BMS11—Structural Properties of the Curren Fabrihome Corporation's Fabrihome Constructions for Walls and Partitions," by Whittemore, Stang, and Phelan. Size 8½ x 11 in.; 14 pages. Procurable from the Superintendent of Documents, Washington; price, 10c.*]

DUST. The Industrial Commission of Illinois during 1938 published new rules concerning the removal of dust and gases from grinding and polishing operations. The new rules went into effect July 15, 1938. [*"Rules Relating to Removal of Dusts, Vapors, Fumes, or Gases from Grinding, Polishing and Buffing Operations of the State of Illinois." Size 6 x 9 in.; 14 pages; obtainable from the State of Illinois Department of Labor, 205 West Wacker Drive, Chicago.*]

INSTRUMENTS. A book dealing with the role of instruments in industry and giving a history of the subject, its sales and the economic effects of instrumentation in industry. The basic principles of the operation of instruments is also discussed. Includes bibliography. [*"Industrial Instruments and Changing Technology," by George Perazich, Herbert Schimmel, and Benjamin Rosenberg, WPA National Research Project, Philadelphia. 7 x 10 in.; paper bound; 148 pages. Obtainable free from the Publications Section, Division of Information, Works Progress Administration, 1734 New York Ave., Washington, D. C.*]

INDUSTRIAL ARCHITECTURE. A book devoted to representative industrial buildings designed by Albert Kahn, Inc. Includes plans, sections, detailed drawings of structural work and mechanical installations and many photographs. Among the building types illustrated are automobile factories, assembly plants, power plants, steel mills, plants for the manufacture of diesel engines, airplane, office equipment, cosmetics, pharmaceutics, and many other products. [*"Industrial Architecture of Albert Kahn, Inc.," by George Nelson. Published by Architectural Book Publishing Co., Inc., 112 West 46th St., New York. Cloth binding; 176 pages; 9 x 12 in.; price, $6.*]

AIR POLLUTION. A discussion of air pollution and its relation to the weather. [*"Air Pollution and Climate," by David R. Morris. Paper presented before the 34th annual meeting of the ASRE, New York, December 7, 1938.*]

THE MONTHLY QUIZ

Only one of the answers given after each of the following questions is correct. Check your answers against those on page 68.

1. Reverse return piping is an arrangement of piping whereby: (1) steam and condensate flow in the same pipe in opposite directions; (2) steam and condensate flow in different pipes in opposite directions; (3) steam radiators are fed from supply mains overhead with returns below; (4) hot water radiators are hooked up so that the first radiator supplied is the last on the return line; (5) refrigerant flows in opposite direction to brine.

2. An inclined gage is: (1) a tool used in laying out elbow patterns; (2) a device for measuring slope in pipe lines; (3) a manometer with a sloped leg for indicating draft; (4) one type of device for recording dust concentrations in air; (5) an instrument for indicating odor intensity.

3. The Chezy formula is used for solving problems in: (1) flow of water; (2) heat of combustion; (3) air-steam mixtures; (4) economics of insulation; (5) roof ventilators.

4. A kata thermometer can be used to measure: (1) acidity of hot water; (2) dewpoint temperatures below 32F; (3) low velocities of air; (4) steam temperatures; (5) corrosion in refrigerant lines.

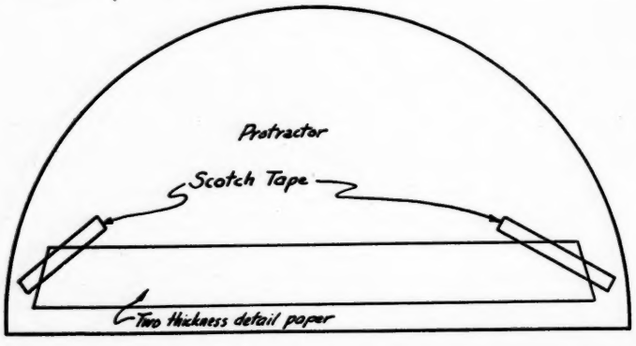
5. A thermal release switch is used to: (1) open a valve to allow steam to blow off; (2) shut off a burner when steam pressure builds up; (3) reject heat from a cooled space; (4) stop a hot water circulator when the thermostat stops calling for heat; (5) shut off current to motor when it is overloaded.

KINKS

Liberal payment will be made for brief articles which are, in the opinion of the editors, useful and generally applicable kinks relating to drafting room, shop, plant, or field practice in the design, installation, operation, or maintenance of heating, ventilating, or air conditioning equipment.

Plotting Curves

While making some degree-day curves along with plotted daily temperatures for use in checking billings of district steam, considerable annoyance was experienced from blotting due to the ink getting under the edge with the bevel side at the bottom to avoid contact with the ruling pen.



The most convenient straight edge for making a large number of short lines is the straight edge of a small celluloid protractor. To avoid blotting raise the edge from the paper by fastening about two thicknesses of detail paper to bottom with Scotch tape, keeping it about ¼ in. from the edge.

This simple expedient will prove to be a time saver and save a lot of erasing on the type of work mentioned.

●

Improving Identifications on Lettering Guides

After using lettering guides they become worn slightly and the identification letters at the top become difficult to read because the gilt lettering falls out of the indentations in the celluloid.

When this happened here, I took the guides so affected (principally the smaller sized ones) and made the identifications readable by rubbing them with ordinary white lead, such as is used by pipe fitters and comes in small cans. After working the white lead into the grooves, the surplus is wiped off and the identifications now stand out in white, making them more readable than the original gilt letters as shipped from the manufacturer. Considerable eye strain is thus avoided. —*Arthur L. Bennett.*

WHAT READERS SAY

Relative Humidity

Editor, HEATING & VENTILATING:

Can you furnish us with any data regarding the relative humidities required at various temperatures in rooms where explosive vapors may be present? We are particularly interested in hospital rooms where ether is present.—R.H.T.

A high dewpoint of the order of 60F, under ordinary room temperatures, is desirable to safeguard against static accumulations and discharges, but it will not necessarily make a room containing explosive mixtures explosion-proof, because water vapor does not affect much the limits of inflammability nor the ignition temperatures of explosive mixtures.

The literature on the subject has been reviewed recently by G. W. Jones and Henry Seaman, of the U. S. Bureau of Mines, in a brief article entitled "Effect of Water Vapor on Ignition Temperature of Methane-Air Mixtures," which appeared in the Journal of Industrial Hygiene & Engineering Chemistry, January, 1934. This paper gives five other references on the subject.

THE PROBLEM CORNER

Two junior draftsmen, A and B, were employed by a contractor at the same time. A's salary was $1000 a year with an increase of $200 a year; B's salary was also to commence at $1000 a year but his increase was $50 every half year. In each case payments were to be made half yearly. Which draftsman received the better offer and why?

If you are doubtful of your solution see page 68.

EDITORIALS

The New Medical Findings on Air Conditioning

The old problem of the heat-regulating function of the human body is receiving more attention of late than for a long time. Medical men have taken up the laboratory study of the relation between the body and its air surroundings as never before. They now have new facilities and new experimental methods to assist in their search. More than that, they now have the incentive of active public interest and a realization that they are exploring a field where they may come onto significant findings at any time.

All this can be contrasted with what happened along this line in the early 1920s. Then engineers and technical men generally were beginning to show signs of interest in this very problem. They were anxious to find out at least enough to permit stable estimating of air cooling and conditioning loads. Their interest found no answering zeal on the part of medical men who generally felt no urge to explore the phenomena of heat production and heat loss of the body. The engineers boasted that they could design practical air conditioning equipment to meet any set of conditions which physicians would ask for. Still there was little response by physicians.

It was not until air conditioning loomed large in public interest that the physiological phenomena of heat regulation inside the body began to attract increasing attention from the physicians best qualified to study it. This newfound interest is all to the good even if a little tardy.

Now, the results are slowly beginning to appear. Already they show signs of upsetting some of the most cherished conceptions of the engineers. The medicos are saying that they can see no reason to believe that relative humidity has much, if anything, to do with the feeling of comfort in the usual range of conditions experienced in winter. They intimate that relative humidity of the air is of importance only under summer conditions. They are reporting that they have generally found no direct traceable relation between the usual air conditioning and health. They are pointing out that uniformly maintained temperatures may not be desirable in assisting the body to perform its functions. One thing they are doing is to point the way towards taking some of the emotion out of present air conditioning practice and to substitute a more factual background.

One of the most challenging and interesting statements made recently was included in the address of Doctor Haggard before the ASME last December when he said: "It is not warm weather acting on man that keeps him free from colds and scarlet fever, or cold weather acting on him that keeps him free from yellow fever. Weather does not cause disease, except sunburn, sunstroke, heat collapse, and frostbite. Most diseases —even the common cold—are due to infections, and it is the parasite that has its climatic preferences. Until the engineer can air condition all outdoors his efforts will have little effect on the occurrence of infectious diseases. And if and when he does condition climate he will not do away with infections but only with the seasonal variations in the kinds of diseases."

Perhaps we are shortly going to see that the medical study of the regulating mechanism and the reactions between the body and its surrounding air will lay a greatly altered foundation to our thinking about the objectives of air conditioning. Probably more remote, but equally possible, is the effect of these findings on our practices as engineers.

◆

Licenses for Installers

Licensing of contractors and dealers who sell or install heating or air conditioning equipment to the public seems on its way. Already a number of the large cities have set up ordinances which require not only a license but the posting of a bond as well. In some cases the annual license fee required is a considerable amount. In some cities also the requirements to be met before a license can be granted look formidable. Almost without exception the ordinances cite the public interest in possible fires and in other public hazards due to faulty installation as the reason for the law. Resting on such grounds there is little doubt that these licensing laws can be considered justified and that courts generally will uphold their legality.

When these laws are in effect it is generally supposed that they will have important results. Among these should be a definite improvement in the qualifications of those who get licenses and the elimination of those not well qualified. Mere requirement of a bond should discourage irresponsibles from attempting to enter the business.

The very fact that licensing is considered necessary in so many localities should be given some thought. It is unlikely that licensing would gain much support unless there were some need for it. The move toward licensing should be considered along with the drawing of codes, the preparation of fair trade standards, and the inspection of completed work by public authorities as evidence that there is widespread dissatisfaction with the installation practices now current. We do not know just how extensive this situation may be but we believe that it will be traced largely to the inrush of new and inexperienced installers into this field in the past several years. In spite of all warnings to the contrary there have been those who have felt that all that is necessary to undertake local installation of heating equipment is a vast confidence in one's own ability, a contempt for all existing experience, and enough money or credit to maintain a payroll and an inventory. Now some of the slipshod work done is beginning to accumulate to such an extent that it is inspiring countermoves to offer purchasers at least some measure of protection. The surest way to avoid the spread of stringent licensing laws is to confine the installation work to those who are thoroughly competent to undertake it.

NEWS OF THE MONTH

Gas Utilities Sponsor Installation Standards for Gas Heating; Winter Air Conditioning "Guide" Available Nationally

NEW YORK—The 18 gas company members of the Metropolitan Heating and Air Conditioning Council who operate in the New York area have prepared a set of rules outlining recommended practices for the installation of gas winter air conditioning in new homes, according to H. P. Morehouse, chairman, sub-committee on improved selling practice, AGA House-Heating and Air Conditioning Committee. The rules are in booklet form titled Gasco Installation Guide.†

H. P. Morehouse, chairman of the sub-committee on improved selling practice.

These standards, prepared by a joint committee of the Council and the Metropolitan Service Managers Group, have created such interest throughout the gas industry that AGA has taken over their distribution on a national basis and is making the book available in quantity to all gas companies, manufacturers, and other interested parties, at a nominal cost.

According to Mr. Morehouse, the reason for the preparation of these standards was to bring order out of the chaotic state into which winter air conditioning was falling because of the unorthodox installation practices that were being followed, including a tendency to chisel and cut corners to a point where unsatisfactory results are the experience of the buyer.

Such has been the history of gas winter air conditioning in the east. During its early history each installation was carefully and individually engineered with satisfactory results. Gas companies encouraged this type of warm air heating because it offered them their best opportunity for getting the home market. It was a low first cost system to install, and had other advantages.

The Council concluded that, this being the case, gas utilities cannot afford to see gas-fired winter air conditioning discouraged by unsatisfactory installations. Such a situation was rapidly approaching, they believed, when the installation guide committee was formed. There was already a trend to other heating systems, particularly forced hot water.

The low-price home and speculative building was the point at which sloppy installation practices first appeared. These practices later spread to the better class home in the dash to cut prices and get the order. Mr. Morehouse enumerates these practices as follows: Sidewalk deliveries of units with the builder hiring his own sheet metal man; in these cases often no layout was ever made, and there was divided responsibility and little supervision. Units were sized wrong, and fans were either too large or too small for the job. Ducts were installed without dampers so that balancing was impossible. Insufficient return area or even a complete lack of return ducts was sometimes encountered. Sheet metal ducts were often improperly run, improperly braced, and made of too light material. Units were installed in inaccessible locations for service. There were many other examples of unsatisfactory practices. Most of the dealers participating in these unorthodox practices did not want to do a poor job, but a vicious cycle had been started and everyone was afraid to check the practices for fear of losing the order.

The gas utilities feel that they are in a somewhat unbiased position and are the only hope for establishing a set of standards which will assure careful and satisfactory installations.

The Gasco Installation Guide was not prepared as a code of minimum requirements, Mr. Morehouse emphasizes, but rather as a set of standards through which everyone concerned could be assured of a first-class installation. Its language is that of "suggestions" rather than "demands." Its rules are not idealistic, theoretical or unnecessary. On the contrary, the rules follow standards suggested by the ASHVE, National Warm Air Heating and Air Conditioning Association, National Board of Fire Underwriters, American Gas Association, and over a hundred manufacturers of gas-fired winter air conditioning equipment.

The question comes up as to how such a set of rules can be made to work. The policy of policing installation practices is something each utility will have to decide upon for themselves. However, the committee offers one possible solution to get the Guide into widespread use. This is a single sheet specification form which may be purchased through the AGA in padded form. This form when signed by the installer is a contract to make the installation according to the precepts of the Gasco Guide. There is room on the form for exceptions to be taken to certain rules. These exceptions are taken in writing and are agreed to in advance between the owner, architect or builder, on the one hand and the dealer or installer on the other. Such a set of standards reduced to a simple contractual agreement offers an advantage also to the dealer. He knows when he places his bid that he is bidding against a comparable installation by his competitor. His interest in cutting corners is thus to a considerable degree diminished. It is urged that all utilities who adopt the Gasco Installation Guide as their standard, furnish all dealers and installers with extra blank copies of the specification form and also to urge architects, builders and prospective home builders, to insist that a signed specification form accompany each dealer's bid.

Chapters of the Gasco Guide include those on equipment approval, heating unit, furnace erection, furnace installation, controls, ducts, grilles, filter, electric connections, balancing of systems, and general.

Since the Gasco Guide represents recommended best practice and not minimum standards, there is room for a lower set of standards to take care of low-priced speculative houses. The Guide is written in "should" and "would" language, with no attempt on the part of the gas company to demand. However, on those items where safety and a reasonable amount of comfort are at stake, there can be no compromises. Examples are sizing the unit, care in its erection, ample supplies and returns, and adequate dampers. These are "must" items on which no compromises should be made.

These "must" items can best be covered by a code of minimum requirements which should be enforced by the utility under penalty of withholding free service from installations not meeting these minimum requirements. Such a code has been drafted by the New Jersey Gas Association.

†*This booklet is abstracted on page 54.*

Buffalo Burner Association Meets

BUFFALO—The newly-organized Buffalo Oil Burner Association considered its constitution and by-laws at a recent meeting in the Hotel Buffalo. About 50 representative dealers in oil-burning equipment for homes and industry in western New York attended.

Principal speaker was Allan Rief, vice-president of the Oil Burner Institute of New York. He reported the industry is enjoying good business and gave the new local organization suggestions for sound growth.

Clayton P. Yoder, of the Buffalo Niagara Electric Corp., presided. His corporation was host to the new association. Other speakers included Joseph Davis, president of the Air Conditioning Council; Herman Bernhardt, vice-president of the Buffalo Stoker Association; William Cusack, of the Anthracite Association, and John J. Landers, president of the ASHVE Western New York chapter.

Chicago Has 2600 A.C. Jobs Totaling 75,000 Tons, Report Shows; Theaters Account for Nearly 30% of Total Tonnage

CHICAGO—On the first of the present year there were over 75,000 tons of refrigeration in the 2600 installations in Chicago proper, according to a summary compiled by the Air Conditioning Division of the Commonwealth Edison Company. The tabulation by this company is most complete and is shown here as Table 2.

From the figures in Table 2 a somewhat shorter calculation of the totals at the beginning of 1938 has been made in Table 1. From this table it will be seen that while the installations in theaters, general offices and buildings, restaurants, hotels, and clubs, industrial buildings, and retail stores account for only a rather small part of the total number of installations made in Chicago, still they account for 92% of the whole tonnage reported in Chicago proper.

In spite of what seems like reasonably good progress in connection with the sale of summer air conditioning equipment to private and professional offices in the past three years especially, it should be noted that the 823 installations reported account for only 1.1% of the total tonnage.

Especially illuminating in the calculation is the fact that the tonnage of refrigeration installed in residences amounts to only one-half of one per cent of the total.

TABLE 1—AIR CONDITIONING IN CHICAGO BY TYPES OF APPLICATION

(As of January 1, 1939)

APPLICATION TYPE	TONS	%
Theaters	22,551	29.8
General offices and buildings	13,895	18.4
Restaurants, hotels, and clubs	13,536	17.9
Industrial buildings	9,823	13.0
Retail stores	9,720	12.8
Banks, brokers, and exchanges	2,631	3.5
Churches, civic buildings, and hospitals	1,129	1.5
Amusements, dance halls, studios	1,085	1.4
Private and professional offices	823	1.1
Residences	388	0.5
Miscellaneous	89	0.1
TOTAL	75,670	100

Norwich Conducts Stove Research

NORTHFIELD, VT.—More efficient use of wood for heating and other household purposes is expected to result from research being made at Norwich University here, in the university's Bureau of Industrial Research. Douglas E. Howes, director, says that by using the principle of slow combustion, the wood is distilled into gas and let into a chamber to be burned under the most favorable conditions possible. Efficiencies of 75 to 90% are expected.

92 A.C. Jobs Added in New York City

NEW YORK—Air conditioning installations in this city during February totaled 92 in number and 295½ in horsepower, according to the Consolidated Edison Company of New York, Inc. Of these, 27 installations, totaling 1144¼ hp., were for the World's Fair.

13 More Chicago Conditioning Jobs

CHICAGO—The Commonwealth Edison Company reports an addition of 13 air conditioning installations to its lines during February. Of these, three were room coolers and ten central systems. The total tonnage added amounted to 90.

TABLE 2—SUMMARY OF AIR CONDITIONING INSTALLATIONS IN CHICAGO PROPER, BY NUMBER AND HORSEPOWER

BUILDING TYPE	PRIOR 1933		1933		1934		1935		1936		1937		1938		TOTAL	
	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
CENTRAL SYSTEMS																
Amusements	0	0	0	0	0	0	0	0	0	0	1	33	3	107	4	140
Banks	6	1,006	1	200	3	46	0	0	2	328	1	5	3	164	16	1,749
Barber shops	0	0	0	0	0	0	0	0	3	9	1	1	0	0	4	10
Beauty shops	1	4	0	0	3	58	7	45	3	47	5	19	8	33	27	206
Brokers and exchanges	4	694	2	26	3	52	0	0	6	110	0	0	0	0	15	882
Churches	1	90	1	5	1	65	1	7	0	0	0	0	3	127	7	294
Civic buildings	1	450	1	116	0	0	0	0	1	150	0	0	1	30	4	746
Clubs	3	357	1	2	0	0	0	0	2	86	1	36	0	0	9	481
Dance halls	4	465	0	0	0	0	0	0	0	0	0	0	0	0	4	465
Doctors and dentists	0	0	0	0	0	0	0	0	0	0	0	0	4	19	4	19
Funeral parlors	2	42	2	10	5	42	10	107	12	131	15	245	20	173	66	750
Hospitals	1	30	0	0	1	5	4	47	0	0	0	0	2	7	8	89
Hotels	13	3,187	3	94	6	124	2	148	7	64	1	1,077	3	44	35	4,738
Industrial																
Bakery	18	303	0	0	0	0	1	1	1	50	1	4	1	15	22	373
Candy	16	2,451	3	738	4	381	5	233	11	437	5	177	2	23	46	4,440
Printing	13	1,800	1	201	5	98	5	145	2	20	6	462	2	46	34	2,772
Miscellaneous	6	609	3	179	9	352	8	113	9	239	7	635	4	111	46	2,238
General offices and bldgs.	18	4,493	9	265	25	1,560	32	700	56	1,756	62	4,249	56	872	258	13,895
Private offices	21	61	18	31	23	85	7	14	18	50	6	14	6	20	99	275
Residences	10	40	2	5	10	52	3	6	5	12	13	40	9	38	52	194
Restaurant	39	1,483	19	448	28	471	49	1,099	66	1,527	102	1,907	88	1,382	390	8,317
Stores																
Candy	0	0	4	13	3	5	8	13	15	73	7	28	13	68	50	201
Clothing, dept.	3	317	2	6	7	1,077	16	449	16	1,174	17	441	24	446	85	3,910
Drug	2	56	0	0	5	104	14	134	13	187	21	187	22	221	77	889
Food	7	385	0	0	0	0	0	0	3	46	6	44	8	32	24	508
Fur	2	15	0	0	3	19	3	13	6	48	6	30	3	16	23	142
Shoes	2	34	1	10	4	29	8	55	10	130	26	341	9	65	60	665
Miscellaneous	2	215	3	448	1	166	8	222	14	867	21	406	6	115	54	2,439
Studios	1	346	1	9	1	12	2	52	0	0	3	10	4	51	12	480
Theaters	54	14,166	14	617	35	2,653	29	1,510	18	1,054	35	1,915	10	636	195	22,551
TOTAL—Central systems	250	33,104	91	3,423	183	7,456	222	5,113	299	8,595	371	12,306	314	4,861	1,730	74,858
ROOM COOLERS																
Doctors and dentists	0	0	2	1	2	2	11	7	9	6	25	20	42	25	91	61
Private offices	0	0	19	28	25	41	53	60	73	65	121	126	194	148	485	468
Residences	0	0	8	10	17	11	21	20	43	30	44	50	101	73	234	194
Miscellaneous	0	0	0	0	6	5	6	6	9	9	9	46	26	23	56	89
TOTAL—Room coolers	0	0	29	39	50	59	91	93	134	110	199	242	363	269	866	812

News of the Month

A.C. "Expert" Wanted by Police

SHREVEPORT, LA.—The Office of the Inspector, Post Office Department, here, has issued a wanted circular covering Carl Sydney Bauman, Jr., alias Miller Dowling, who was indicted in the Federal Court at Shreveport, La., on March 1 for fraud. This man has victimized a number of persons connected with refrigeration and air conditioning concerns and apparently specializes in engineering firms.

He poses as a refrigeration and air conditioning engineer and seems to be well versed along these lines. He is described as white, 40, 5 ft. 10 in., 165 lb., fair complexion, blue eyes, medium brown hair, polite and suave, an inveterate cigaret smoker, and a hard drinker. Has long pointed nose, protruding ears, and tattoos of a snake and eagle on the left arm and a dragon on the right arm, a scar on upper lip extending to left cheek. The United States Marshal here holds a warrant for his arrest and if anyone locates him he is requested to arrest him and wire F. L. Clampitt, Post Office Inspector in Charge, Forth Worth, Texas.

Unit Heater Committees Named

DETROIT—Albert J. Nesbitt, president of the Industrial Unit Heater Association has announced the following committee appointments for the ensuing year:

Engineering committee—E. R. Walker, chairman, and one technical representative of each company; Finance—A. G. Dixon, chairman, and H. Mathis; Membership—M. F. May, chairman, E. W. Petersen, and P. Schoepflin; Publicity—T. Brown, chairman, and N. Downey; Trade Relations—Eastern Division, J. F. G. Miller, chairman, and H. S Wheller; Western Division, J. M. Frank, chairman, and R. W. Nelson.

The second regular meeting of the Association will be held in Cleveland, April 26, when further consideration will be given to the standardization program sponsored by the engineering committee.

Paterson Dealers Start Drive

PATERSON, N. J.—Automatic heating, refrigeration, and air conditioning dealers here cooperated in launching an active sales season with a spécial Spring Opening Week during which a city-wide display of new appliances was conducted in individual dealer showrooms. The event was ushered in March 23 with 10 full pages of advertising and publicity in the Paterson Morning Call.

Included among participating dealers were H. B. Kitay, Meyer Brothers, Standard Plumbing & Heating Co., H. M. Ash Co., Barney's, Quackenbush's, Public Service, Ritman's, S. & S. Furniture Co., Scott & De Palma, Slater's, and Sears.

Iowa State to Hold 4th A.C. Meeting

AMES, IOWA—The Fourth Iowa Heating and Air Conditioning Conference will be held at Iowa State College here April 11-13, according to an announcement early in March. In addition to a three-day program of papers and talks there will be an exhibit of the latest heating and air conditioning equipment.

On April 11, the following subjects will be treated: A Study of Heating and Ventilation of Public Schools; Engineering Contracts as Related to the Field of Heating, Ventilation, and Air Conditioning; and Water Supply and Disposal for Air Conditioning in Iowa.

On April 12 are scheduled Sales Developments in Air Conditioning; Zone Control for Automatic Heating; A Sales Program for Oil Burners; Installation and Maintenance of Service on Oil Burners; The Fuel Oil Situation; Experiments on Oil Burner Operation; and Securing Satisfied Customers.

On April 13 the conference will cover Dustless Treatment for Stoker Coal; Coal Marketing in Iowa; Furnishing Complete Heating Service; Recent Developments in Coal Stoker Design; Stoker Servicing; and The Summer Hot Water Problems.

There will be thirty-five exhibits of heating and air conditioning equipment, oil burners, coal stokers, control equipment, insulation, and allied products.

The conference is under the auspices of the College and the Iowa-Nebraska chapter ASHVE. There will be no charge for enrollment.

Charles Elected by British Group

LEICESTER, ENGLAND—Walter Charles, assistant manager of Ashwell & Nesbit, Ltd., of this city, has been elected president of the British Association of Heating, Ventilating & Domestic Engineers Employers. Mr. Charles, who has been connected with the company for 36 years, is well known in the United States, his most recent visit having been in 1938.

Walter Charles

Mr. Charles is chairman of the Heating & Domestic Engineers National Joint Industrial Council; of the Birmingham Area Committee of the National Apprenticeship Council, and of the Automatic Stoker Control Association. He is also a member of the Engineers' Advisory Committee of Birmingham College of Technology, and of the committee of the East Midlands Branch, Institute of Heating and Ventilating Engineers.

Foundry Dust Situation Studied

NEW YORK — Dust concentration in the foundries in New York State is the subject reported on by Theodore Hatch, C. E. Williams, and B. G. Dolin, of the Division of Industrial Hygiene of the State Department of Labor, made public early in March. The purpose of the survey was to determine the relation between representative foundry operations and dust concentrations, the levels of dustiness which represent good practice in foundry dust control, and to what degree are dust concentrations affected by the type of foundry.

The report states that the problem of dust control is particularly serious in foundries employing less than 10 men. It indicates that a consideration of the data resulting from the survey suggests that all foundry dust concentration can be reduced to 30 million particles per cubic foot with a median concentration of 15 million. Such a standard is attainable by practical methods of dust control.

County May Ban Air-Borne Odors

NEW BRUNSWICK, N. J. — Establishment of a county health board to combat air-borne odors has been recommended to the Mayors' Association of Middlesex County by Mayor Richardson of this city. Only one or two municipalities are attempting to correct conditions created by odors emanating from Middlesex and Somerset county industrial plants, he said. The mayors' group was advised by D. Marsh Vail, superintendent of the local sanitation plant, that a bill had been prepared for introduction in the state legislature to restrain factories from polluting the air.

Apt Addresses Boston A.C. Bureau

BOSTON—Sanford R. Apt, chief mechanical engineer of the New York World's Fair, was the guest speaker at the March 15 meeting of the Air Conditioning Bureau. His subject was Comfort in the World of Tomorrow. His talk was illustrated, showing the prime importance attached to air conditioning in carrying out the theme of human comfort in The World of Tomorrow, feature of the New York World's Fair. Mr. Apt has been in charge, for the past three years, as chief mechanical engineer, of the design and installation of air conditioning, heating and ventilating for this great project.

Delaware Bill Favors Plumbers

WILMINGTON—Delaware House Bill 91, passed the House March 1. This bill was introduced February 10 and is intended to place the installation of oil burners in the State of Delaware under the jurisdiction of plumbers.

Gov't Planning Anti-Trust Action

WASHINGTON—The Administration is preparing to bring new anti-trust actions in at least five industries, including building materials, it was revealed March 22.

The revelation was made by Assistant Attorney General Thurman W. Arnold in testimony before the House Appropriations Deficiency subcommittee.

Arnold said anti-trust cases are being considered in the fertilizer, newsprint, shoe machinery, tobacco, building materials industries, and ten new cases in the motion picture industry.

He testified in support of a request for a $70,000 deficiency appropriation to pay additional anti-trust personnel between now and July 1. The request was disallowed by the committee with the suggestion that it be considered in connection with the Justice Department's regular budget for the next fiscal year.

The proposed actions were not discussed in detail by Arnold, except that covering building materials, which he asserted should be of benefit in reducing housing costs.

Boston Now Has 1435 A.C. Systems

BOSTON—In a summary of air conditioning installations in Boston and vicinity, together with a detailed list of those of 1938, the local Air Conditioning Bureau has prepared a chart showing the horsepower increase in air conditioning from 1932 to 1938, inclusive. Total increase during 1938 over previous year was 2182 hp. to a grand present total of 16,609. In 1932 total connected horsepower was 4,168, and each year has shown steady increases although that of 1938 did not equal that of 1936, when 2746 hp. were added to the grand total.

Analysis of 1938 installations shows 95 commercial installations, including cooling and year-round systems with refrigeration; 10 institutional, 113 industrial systems with refrigeration; 1,072 residential winter air conditioning systems, and 250 self-contained room cooling units, to a total of 1,435 separate systems.

Oregon Capitol to Have New Plant

SALEM, OREG. — Plans have recently been completed for a new heating plant for the state capitol here. The plant will be located in a one-story building, 56 x 107 ft., and cost approximately $125,000. In this building will be housed three boilers with space for an additional boiler when needed. Steam lines will be carried underground in new tunnels to feed the five buildings comprising the capitol group.

Land has been acquired and space left for storage of hog fuel which will be used in the heating plant.

Proposed Retail Tax Affects A.C.

BOSTON—Again the proposition for a retail sales tax has bobbed up in the Massachusetts legislature. A retail sales tax bill submitted by Tax Commissioner Henry F. Long, to net forty million dollars to ease the burden on realty, is meeting with tremendous opposition from retailers and consumers.

Items included in the proposed tax, irrespective of price, are air conditioning equipment and oil- or gas-burning heating equipment. There is also a long list of other items.

Both bills require every retail dealer in the state to register with the Tax Commissioner, pay one dollar license fee and make monthly reports accompanied by payment of the sales tax, collected from buyers, sellers becoming responsible for its collection.

Fair Air Conditioning Described

NEW YORK—The New York World's Fair of 1939 was described to the members of the ASHVE New York chapter at the regular monthly meeting, March 20.

Col. H. W. Durham, of the Fair's construction department, described the civil engineering in connection with the Fair, including the levelling off of the site, water supply, landscaping, drainage, roadways, and river control. He was followed by Joseph Judge, architect, coordinator of the Fair's board of design, who explained the features of the basic plan of the Fair and outlined the functions of the different sections.

Sanford Apt, chief mechanical engineer of the Fair, described the air conditioning of the Fair, particularly that done by the Fair Corporation itself and including the conditioning of the administration building and perisphere.

At the meeting a proposal was made to increase the Board of Governors from three to five but discussion was held over until the next meeting.

McIntire Begins Presidential Tour

BUFFALO—James F. McIntire, Detroit, president of the ASHVE, discussed The Birth of Air Conditioning at a meeting of the society's Western New York chapter in the University Club.

Mr. McIntire addressed a regular meeting of the Atlanta chapter on March 20, luncheon meetings at Birmingham, March 21, New Orleans March 23, and Houston March 25.

He also attended meetings of the North Texas chapter, Dallas, March 27, and Oklahoma chapter, Oklahoma City, March 29. Scheduled are addresses before the Southern California chapter, Los Angeles, April 11; Golden Gate chapter, San Francisco, April 18; Pacific Northwest chapter, Seattle, May 1, and Illinois chapter, Chicago, May 15.

Houghten Is Speaker at Detroit

DETROIT—The March meeting of the ASHVE Michigan chapter was National Society Night, and J. F. McIntire, national president, J. H. Walker, vice-chairman of the research committee, and F. C. Houghten, director of the Research Laboratory, were the speakers of the evening.

Mr. McIntire spoke briefly on the history of the Michigan chapter and also gave a short resume of the history of the air conditioning industry. Mr. Walker discussed the cooperative research as carried out by the committee on research. At the present time, there are 12 universities cooperating with the research laboratory on air conditioning studies.

Mr. Houghten discussed Physiological Response to Atmospheric Environment, in which he outlined the development of the effective temperature lines on the comfort chart and the effect that atmospheric conditions have upon the heat loss of the body by radiation and convection. He also discussed the effect of surrounding air conditions on the leucocyte count of blood in the human body.

Triple Filtering in Drug Plant

DETROIT—Five departments in the new Parke, Davis and Company building here are used for preparations of such a nature that the conditioned air supplied to the rooms is triple filtered to assure sterilization. The air in thirty biological rooms, filling department, mill room, and vacuum dryer room is maintained at the temperature, relative humidity and the rate of flow needed in each of the spaces. Heated air with constant temperature control is also supplied for the incubator room.

Preparation of biological products must be done in conditioned air to assure high quality. Filters located in the inlet of the air conditioning units provide the triple filtering for sterilization of the air. Temperature of 80F with a relative humidity of 35% is maintained by Carrier systems.

Liquid Level Control Described

BOSTON—Liquid Level Controls was the subject of discussion at the March 10 meeting of the Boston section, ASRE, held at Northeastern University. Jacob L. Turner, treasurer and engineer of the Milton Ice Company, was the guest speaker. He has recently developed a control which will maintain levels within a fraction of an inch of any desired pressure, when operating in conjunction with solenized or motorized valves, motor-driven pumps, and other electrical equipment. His talk was illustrated with lantern slides and a working model. Following the lecture the audience made a tour of Northeastern University's new engineering laboratories.

O.B. Standards Committee Meets

NEW YORK—The Oil Burner Industry Standards Committee met recently for the purpose of drawing up a laboratory testing procedure on oil burners in connection with the factory production standards that have already been developed. It is expected that these specifications will be sent to several laboratories for competitive bidding. The specifications themselves and the laboratory bids will be submitted to the industry at a meeting scheduled to be held at the New Yorker Hotel here Monday, April 17, the day preceding the annual meeting of Oil Burner Institute.

Van Alsburg Speaks in Toronto

TORONTO—The March meeting of the ASHVE Ontario Chapter was held recently in the Royal York Hotel with 69 members and guests present. The speaker of the evening was J. H. Van Alsburg whose subject was the Four D's of Air Conditioning.

John Fox introduced the matter of the Engineering Alumni Association of the University of Toronto Triennial Award to be given every three years to an outstanding student or engineer who had done some outstanding work in the particular branch of his profession and J. Fox moved that H. H. Angus, Hugh Jenney, and C. Tasker, act as a committee to send in to the Association the name of some engineer whom they thought worthy of such award.

Urges City Inspection of Heating

TORONTO—The Toronto District Labor Council at a recent meeting went on record demanding that the city administration take steps that would require supervision of all heating plant installations. Much concern has been felt in labor and civic circles over this matter, especially since the asphyxiation of the wife and son of a local Chinese as the result of a faulty installation of a heating system.

Proposed Licensing Bill Killed

ALBANY, N. Y.—The Ways and Means Committee of the New York State Legislature on March 7 killed a bill proposing to license all air conditioning installers operating in the state. This bill was described on these pages last month.

Air Conditioned Liner Launched

BOSTON—The new Panama Railroad Steamship Line's *S. S. Cristobal* was launched at the Fore River plant here recently. The 493-ft. ship, which cost $4 million, has an air conditioned dining room; passengers' and crew's staterooms are mechanically ventilated.

Warm Air Convention Scheduled

COLUMBUS—According to L. R. Taylor, president, preparations are being made for the mid-year meeting of the National Warm Air Heating and Air Conditioning Association to be held at the Stevens Hotel, Chicago, June 5-7.

A unique entertainment on one evening and the annual golf tournament are among the entertainment features. Manufacturers, engineers, and contractors identified with this growing business always look forward to the meetings of this organization as an opportunity to become posted as to new developments.

Allen W. Williams, 5 E. Long St., this city, is the managing director of the association.

Hear Air Distribution Discussed

PITTSBURGH—The March meeting of the ASHVE Pittsburgh chapter had as its main event a lecture given by F. J. Kurth, Anemostat Corp. of America, who spoke on the Theory and Practice of Air Distribution in Air Conditioning Systems. The subject of grilles, their use, their limitations, and how the Anemostat came into being was discussed. The meeting ended with a smoke test of the device described by the speaker.

Harbula Retained by Sears, Roebuck

WHEATON, ILL.—M. G. Harbula and Associates, consulting air conditioning engineers, report that Sears, Roebuck & Company has again retained the organization to air condition two more of its larger stores, one in Des Moines and the other in Cincinnati. The firm has also been retained by the Federal Bank of St. Louis to air condition the large institution occupied by the bank, and the branch banks in Memphis, Louisville, and Little Rock.

Montreal Chapter Hears Drinker

MONTREAL—Philip Drinker, of the Harvard School of Public Health and inventor of the first successful iron lung extensively used in hospitals, addressed the recent meeting of the ASHVE Montreal chapter on air conditioning in relation to industrial health.

Philadelphians Addressed by Kurth

PHILADELPHIA—Nearly 200 engineers, architects, and contractors met February 27 at the Engineers Club of Philadelphia for a meeting at which F. J. Kurth, vice-president and technical director of the Anemostat Corporation of America, read a paper on Theory and Practice of Air Distribution in Heating and Air Conditioning Systems. The meeting was held at the invitation of the Anemostat Corporation and the Sheffler-Gross Co., sales engineers of this city.

Jersey Utility Adds 1553 Gas Jobs

NEWARK—According to the annual report of the Public Service Corporation of New Jersey, sales of gas for building heating by the corporation established a record in 1938, increasing 18.9% over the amount sold in 1937 for this purpose. During the year building heating installations on the company's lines increased by 1553. On December 31 there were 8323 gas-heated buildings supplied by the company.

Seattle to Have New A.C. Ordinance

SEATTLE—This city is shortly expected to have new municipal regulations to govern the installation of systems for forced warm air in buildings and homes as well as new air conditioning plants. The heating and ventilating engineers of the city, especially the members of the ASHVE Seattle chapter, have been holding meetings to discuss plans for such an ordinance in the Puget Sound metropolis.

New Jersey Oil Men Elect Osbahr

NEWARK, N. J.—The New Jersey Oil Trade Association installed new officers at its spring frolic, March 9, at the Robert Treat Hotel here, as follows: president, Theodore W. Osbahr, Solar Fuel Co.; vice-president, Lawrence A. Ryan, Ficke Brothers Refining Co.; treasurer, William Ulrich, American Oil & Supply Co., and Joseph H. Gunn, secretary.

Included among the new directors are: Fred B. Loeffler, Frank P. Mahoney, Frank G. Campbell, John F. Jones, A. L. Saltzman, Bernard Shoobs, James F. Sheehan, Frank P. Gill, M. H. Kurkjian, and H. K. Seywert. Milton Maybaum and Arthur Phillips are national councilors.

James D. Ross

SEATTLE—James Delmage Ross, administrator of the Bonneville Dam project, and also known for his research in electric heating, died March 14 at Mayo Brothers clinic, Rochester, Minn., at the age of 66.

Mr. Ross was an outstanding proponent of plans to heat extensively with conversion of current. For some years he had been engaged in producing a practical electric heater for buildings in mild climates such as the Northwest Pacific Coast, where electricity is cheap.

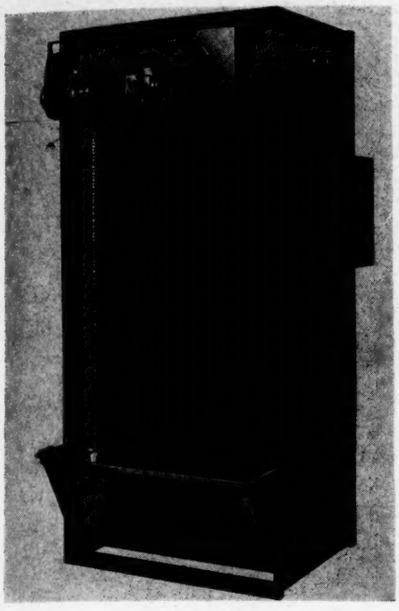
James K. Peacock

NEW YORK—James K. Peacock, assistant secretary of Hoffman Specialty Co., Waterbury, Conn., died at his home here March 7, at the age of 70.

Born in Indianapolis, Mr. Peacock was associated with Hoffman for twenty years. He recently was made a life member of the ASHVE.

He is survived by a sister.

NEW EQUIPMENT



American Air Filter

NAME—Electro-Matic air filter.
PURPOSE—For removing dirt particles of practically all sizes from air.
FEATURES—This filter is a combination of an automatic air filter with an electrical precipitator. In operation the front curtain of the Electro-Matic filter acts as a precleaner to remove the heavier dust particles and any bugs, butterflies, or scraps of material that might short circuit the ionizer or the collector plates in the rear curtain. Fine dust and smoke particles which escape the front curtain then pass through the ionizing unit in the center of the filter where they receive a definite electrical charge. Upon entering the electrostatic field of the rear curtain these ionized dust particles are attracted to the charged plates where they are held securely in the oil film on the plates until removed in the oil bath.

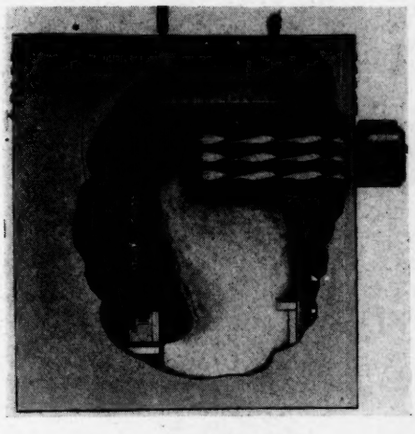
The filter curtain of the Electro-Matic filter is of a new design, which provides the necessary electrical insulation of the plates and a means for charging or grounding alternate plates in certain sections of the curtain. It meets the additional requirement of reverse direction of rotation so that the accumulation of dust and dirt on the front curtain is carried directly down into the reservoir where it is removed by the cleansing action of the oil bath, leaving the rear curtain clean and freshly oiled at all times.

The entire casing of the filter, as well as the front curtain, is grounded. The ionizer is entirely enclosed within the filter and the rear curtain, which is the only exposed part that carries an electrical charge, is protected by a heavy close-mesh grille which prevents accidental or intentional contact.

The Power Pack which furnishes the current for the ionizer and collector plates is mounted directly on the filter casing and all internal electrical connections are made at the factory. Erection is a matter of installing the sections and making the necessary external connections from filter drive and Power Pack to a 110-volt, alternating current lighting circuit.
SIZES—In standard sections of varying heights from 5 to 13 ft.
MADE BY—*American Air Filter Co., Inc., Louisville, Ky.* 1

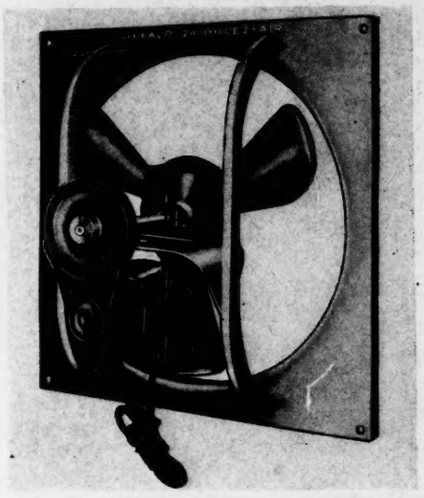
Fitzgibbons Steel Boiler

NAME AND MODEL NUMBER—Fitzgibbons 400 series steel boiler.
PURPOSE—For use with steam, vapor, vacuum, or hot water heating systems utilizing oil, gas, or coal as a fuel.
FEATURES—The following features are said to be incorporated in this new steel boiler: copper-steel welded construction throughout, large combustion area, domestic hot water supply—tankless or with storage tankheater, heavy insulation, refractory-lined service door, standard location of controls, equipped for low water cutoff, enclosing jacket for concealed mechanically-fired units and standard jackets for exposed mechanically fired units.
SIZES—Made in three sizes beginning at 400 sq. ft.
MADE BY—*Fitzgibbons Boiler Co., Inc., New York.* 2



Buffalo Forge Attic Fan

NAME—Breez-Air fan.
PURPOSE—For attic cooling of residential and industrial buildings.
FEATURES—All fans of this line have a panel of heavy gage steel with flanged edges which make it easy to install in a penthouse or opening in the wall. The 24-, 30-, and 36-in. sizes are supplied with a newly developed type of motor mounting attached to the panel. Forty-two and 48-in. fans have a three-point mounting while the 54-in. fan is furnished with a heavy angle iron ring with a three-point tripod mounting. The industrial Breez-Air fans feature increased fan speeds with larger motors and increased capacities. They can be used in any location where a commercial ventilating fan of any type can be used and are much less noisy than a direct connected fan.



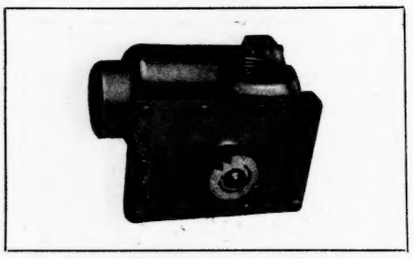
SIZES—Residential line, 24 to 54 in.; industrial line, 24 to 48 in.
MADE BY—*Buffalo Forge Co., Buffalo, N. Y.* 3

Flower City Fire Starter

NAME—Kindle-Pac.
PURPOSE—For starting coal fires in furnaces, boilers, or pot stoves.
FEATURES—This fire starter is a 14-oz. bag of specially treated paper and charcoal which ignites at the touch of a lighted cigarette or match. The bag is placed on the grates of the furnace, touched with the lighted end of a cigarette, and the coal poured on top of it.
MADE BY—*Flower City Charcoal Co., Rochester, N. Y.* 4

Ad-Lee Room Ventilator

NAME—Health-Air room ventilator.
PURPOSE—For providing positive ventilation, air cleaning, noise elimination, and control air circulation.
FEATURES—Unit is designed for window installation and is enclosed in a steel cabinet. Consists of two blower type fans, throwaway type filters, louvers to regulate direction of the air, and a motor rheostat to regulate the speed.
SIZES—16 x 8 x 14 in.
MADE BY—*The Ad-Lee Co., Inc., Chicago, Ill.* 5



Bell & Gossett Watermixer

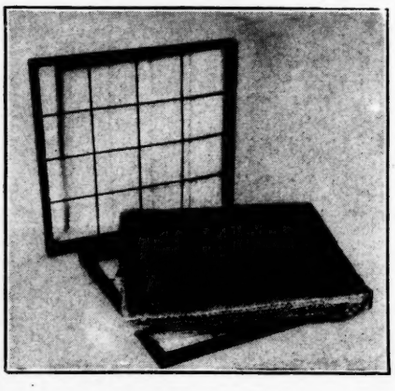
NAME—B & G Watermixer.
PURPOSE—An adjustable tempering valve for mixing cold and warm water to get water at desired temperature.
FEATURES—Watermixer utilizes a bimetal coil submerged in the mixed water to open and close a balanced valve. The manufacturer states that the valve is so constructed that the differences in pressure throughout do not affect its operation and that the temperature of the outlet water remains constant for any rate of draw within the capacity of the valve.
SIZES AVAILABLE—½, ¾, and 1 in.
MADE BY—*Bell & Gossett Co., Chicago, Ill.* 6

Autovent Attic Fans

NAME—Coolvent attic fan.
PURPOSE—For supplying outside air to residences.
FEATURES—To a heavy square sheet steel panel is welded steel tubing for fan support arms. The fan shaft is supported by two bearings, mounted in new flange type rubber pillow blocks. A rubber mounted semi-enclosed motor is mounted on a platform securely welded to the steel plate panel. Fans operate at slow speeds from 281 to 577 r.p.m.
SIZES AND CAPACITIES—Six sizes with capacities ranging from 4070 c.f.m. to 21,100 c.f.m.
MADE BY—*The Autovent Fan & Blower Co., Chicago, Ill.* 7

Research Products Air Filter

NAME—Walton air filter.
PURPOSE—For cleaning air.
FEATURES—Filter consists of a permanent steel frame and grid housing a replaceable filter element which may be thrown away when dirty. A new filter element may be then snapped into place. The manufacturer states that the dirty element may be easily disposed of since it contains no wires and may be folded for disposal in the firebox or garbage receptacle. It is also stated that since the frame is rigid no angle irons or special supports are needed to hold the filter in place so that production costs may be lowered when this filter is used.
MADE BY—*Research Products Corp., Madison, Wis.* 8

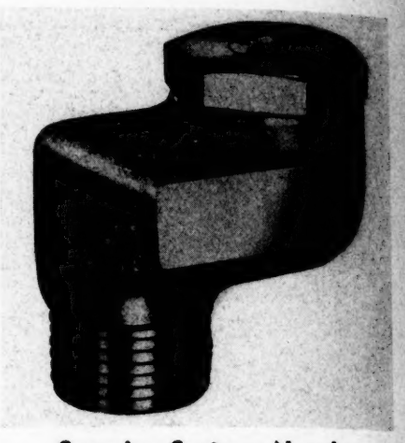


Minneapolis-Honeywell Timing Switch

NAME AND MODEL NUMBER—Timer, type S403A.
PURPOSE—For automatically breaking an electric circuit at a predetermined time for any period from ½ hr. to 11 hr.
FEATURES—Timer is designed to be used to control attic fans, store lights, and other time switch equipment with a non-inductive load of 10 amp. at 110 volts or 5 amp. at 220 volts. The timer may be manually set to close the circuit and will automatically break the circuit at the predetermined time. In order to put the timer in operation it is merely necessary to twist the knob on the front of the timer until the required time interval appears on the dial. The twist of the knob in a counterclockwise direction will turn off the current at any time it may be necessary. Timer is arranged for mounting on a standard switch outlet box.
MADE BY—*Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.* ...9

McLeod & Henry Baffle Plates

NAME—Steel mixture refractory baffle plates.
PURPOSE—A refractory baffle plate designed to be suspended over the fuel bed in domestic stoker furnaces.
FEATURES—These plates are made from "steel mixture" quality Pennsylvania fire clay refractory which is said to have a fusion point of approximately 3200F and to be highly resistant to spalling from frequent temperature changes. The baffle is installed by placing the two halves together and utilizing a tongue and groove joint to align them. A cast-iron clamp is placed on the lug on top of the baffle and one end of a chain or rod is then attached to the clamp and the other end to some overhead projection inside the furnace.
SIZES AND STYLES—Stock sizes, 12, 14, 16, 18, 20, 22, and 24 in. diameters. Rectangular baffles are 14 x 12, 16 x 12, 18 x 14, 20 x 14, 22 x 16, and 24 x 16 in.
MADE BY—*McLeod & Henry Co., Inc., Troy, N. Y.* 10

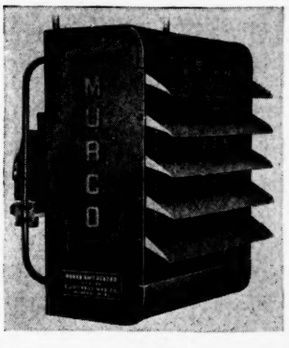


Spraying Systems Nozzle

NAME—Whirljet angle type spray nozzle.
PURPOSE—For spraying liquids in air washers, brine sprayers, or chemical processes.
FEATURES—A non-clogging, centrifugal type nozzle with a pipe connection parallel to the direction of spray. The manufacturer states that the nozzle produces a hollow cone spray with uniform distribution. The nozzles have large passages which are said to make them practically clog-proof. Standard stock construction is brass. Other metals can be specified. Furnished with a ⅜-in. male pipe connection.
CAPACITIES—Six capacities ranging from 0.5 to 2.5 g.p.m. at 10 lb. pressure.
MADE BY—*Spraying Systems Co., Chicago, Ill.* 11

Murray Unit Heater

NAME—Murco unit heater.
PURPOSE—For supplying warm air using steam as a source of heat.
FEATURES—The heating elements in these unit heaters are constructed of copper tubes that are expanded into alloy cast-iron headers. The condenser is attached to the casing by a special spring support device so that the condenser is full floating to overcome contraction and expansion.
SIZES AND CAPACITIES—Twenty-five models with capacities ranging from 20,600 to 556,000 B.t.u. per hr. with air delivery of 430 to 8600 c.f.m.
MADE BY—*D. J. Murray Mfg. Co., Wausau, Wis.* 12



Johns-Manville Refractory

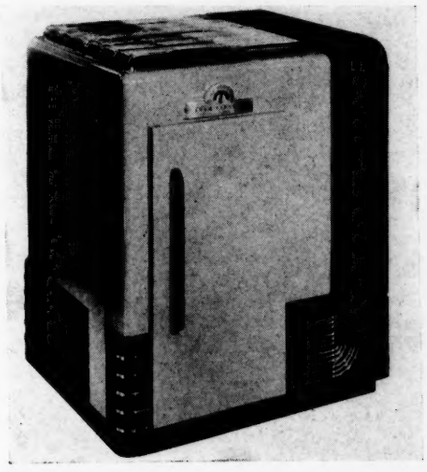
NAME—Light Weight Firecrete.
PURPOSE—For making special refractory shapes, for replacing difficult brick construction, for lining furnace doors, and for making small monolithic linings.
FEATURES—This refractory is said to be suitable for working temperatures up to 2200F and to be four times as effective as firebrick in retarding heat, while having only half its weight. It is also said that its resistance to spalling is such that it will withstand direct exposure to flame temperatures. Sixty-five pounds of the material are required per cubic foot of finished construction. The material can be used to form any required refractory shape simply by mixing it with water and casting it into a form. The manufacturer states that 24 hr. later the shape is ready to be placed in service.
MADE BY—*Johns-Manville Corp., New York, N. Y.* *13*

Minneapolis-Honeywell Gas Combustion Regulator

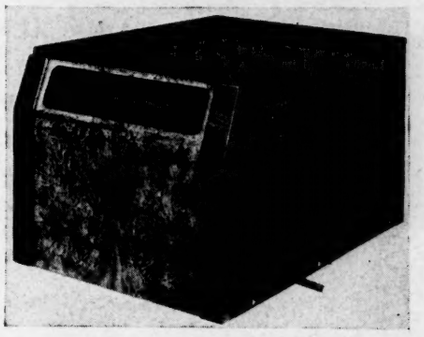
NAME AND MODEL NUMBER—Gas combustion regulator V080A.
PURPOSE—To hold steam pressure in a gas-fired boiler within close limits and to control air supply to burner in conjunction with the gas.
FEATURES—Regulator can be installed to automatically control any radiant or blue flame burner of the atmospheric type. Control is mounted on a gas valve bonnet at a single point and a ¼-in. steam supply and exhaust line and connection to the electric service complete the installation. One of the functions of the regulator is high pressure control. A terminal panel, however, can be arranged for easy incorporation of additional safety devices, such as a low water cutoff, pilotstat, or a Protectoglo flame safeguard relay. Any interruption of the electrical safety circuit will cause complete shutdown of the gas valve.
MADE BY—*Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.* ..*14*

Iron Fireman Unit Heatmaker

NAME—Iron Fireman Unit Heatmaker.
PURPOSE—For supplying warmed, humidified, and circulated air in homes and small business structures. Uses bituminous or anthracite coal as a fuel.
FEATURES—The Unit Heatmaker is a combination of a hopper model automatic coal burner, a room furnace, a forced circulator, and a humidifier. It is said to provide complete automatic temperature regulation including day and night control. The entire unit is enclosed in a modern cabinet. It is said that great pains have been taken to insure dustless operation and special provision has been made for the removal of ash and clinker. An ash receptacle is installed inside the door where it is sealed from the circulated air. Fumes pass into the heater and not into the room. The hopper lid is furnished with a rubber seal to make it dust-tight.



SIZES AND CAPACITIES—Made in two series, 200 and 400. The 200 series hoppers will hold 200 lb. of coal and the fans will supply 600 c.f.m. at an average temperature of 250F. Hoppers of 400 series units will hold 350 lb. of coal and the fans will supply 1200 c.f.m. at 250F.
MADE BY—*Iron Fireman Manufacturing Co., Cleveland, Ohio, and Portland, Oreg.* *15*



Kauffman Air Conditioning Units

NAME—Portable room coolers.
PURPOSE—For summer conditioning.
FEATURES—The first of these units is an air cooled portable window type and is designed to be installed in any window 26 in. or wider. The only connection required is to the electrical line. The manufacturer states that this unit will cool 1500 cu. ft. under ordinary conditions. The second is a portable room cooler and requires electrical and water connections. It is said that this unit will cool 4000 cu. ft. of air space under average conditions.
CAPACITIES—Window unit, cooling capacity 4000 B.t.u. per hr.; room unit cooler, 10,000 B.t.u. per hr.
MADE BY—*Kauffman Air Conditioning Corp., St. Louis, Mo.* *16*

Perham Air Conditioning Unit

NAME—Perham air conditioning unit.
PURPOSE—For heating, cooling, dehumidifying, filtering, and circulating.
FEATURES—This unit requires the following connections: steam or hot water, electrical and refrigerant or chilled water. A twin fan unit circulates the air after it has been filtered. Fresh air intake permits the introduction of outside air. If desired, the unit may be partially recessed in a wall and all parts are said to be readily accessible. Cabinets can be furnished to suit any decorative scheme.
SIZES AVAILABLE—Seven standard sizes.
MADE BY—*Perham Products, Inc., Chicago, Ill.* *17*

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below circle the item number of the equipment in which you are interested, using the number found at the end of each item.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

(This service available only to engineers or executives)

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Degree-Day Figures for February, 1939

HEATING & VENTILATING continues its eleventh year of publishing degree-day data for various large cities

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for February, 1939.....	1127	425	651	368	920	1055	1264
Degree-days, Sept. 1, '38 to Feb. 28, '39	4945	2079	2954	1831	3999	4499	5544
Degree-days, Sept. 1, '37 to Feb. 28, '38	4733	2451	3290	2139	4306	4906	5611
Degree-days, Sept. 1 to Feb. 28, Normal	4868	2370	3462	2023	4322	4768	5496

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for February, 1939.....	1282	1051	825	919	871	1098	1218
Degree-days, Sept. 1, '38 to Feb. 28, '39	5224	4174	3378	3838	3634	4223	4446
Degree-days, Sept. 1, '37 to Feb. 28, '38	4928	4659	3902	4388	4127	3829	4903
Degree-days, Sept. 1 to Feb. 28, Normal	5179	4582	3666	4441	4113	4273	4935

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for February, 1939.....	1068	1004	1648	600	975	779	1010
Degree-days, Sept. 1, '38 to Feb. 28, '39	4434	3584	6568	2199	4060	3010	4146
Degree-days, Sept. 1, '37 to Feb. 28, '38	4897	3704	6792	1757	4607	3403	4717
Degree-days, Sept. 1 to Feb. 28, Normal	4718	3958	6634	2101	4434	3348	4503

	Fort Worth, Tex.	Grand Rapids, Mich.	Green Bay, Wis.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Ithaca, N. Y.
Degree-days for February, 1939.....	552	1063	1354	805	941	891	1009
Degree-days, Sept. 1, '38 to Feb. 28, '39	1884	4341	5272	3750	4145	3616	4591
Degree-days, Sept. 1, '37 to Feb. 28, '38	1866	4917	5773	4039	4420	4245	4862
Degree-days, Sept. 1 to Feb. 28, Normal	1904	4863	5778	4077	4416	4099	4851

	Kansas City, Mo.	Knoxville, Tenn.	La Crosse, Wis.	Lansing, Mich.	Lincoln, Neb.	Little Rock, Ark.	Los Angeles, Calif.
Degree-days for February, 1939.....	996	504	1343	1130	1194	589	305
Degree-days, Sept. 1, '38 to Feb. 28, '39	3489	2572	5170	4720	4091	2292	820
Degree-days, Sept. 1, '37 to Feb. 28, '38	3902	2889	5553	5213	4516	2450	601
Degree-days, Sept. 1 to Feb. 28, Normal	3861	2964	5578	5202	4643	2380	1016

	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.	Nashville, Tenn.	New Haven, Conn.
Degree-days for February, 1939.....	752	1276	550	1172	1563	582	868
Degree-days, Sept. 1, '38 to Feb. 28, '39	3055	4989	2232	4604	5798	2532	3881
Degree-days, Sept. 1, '37 to Feb. 28, '38	3528	5523	2493	5058	5992	2892	4146
Degree-days, Sept. 1 to Feb. 28, Normal	3327	5557	2470	5185	5950	2850	4230

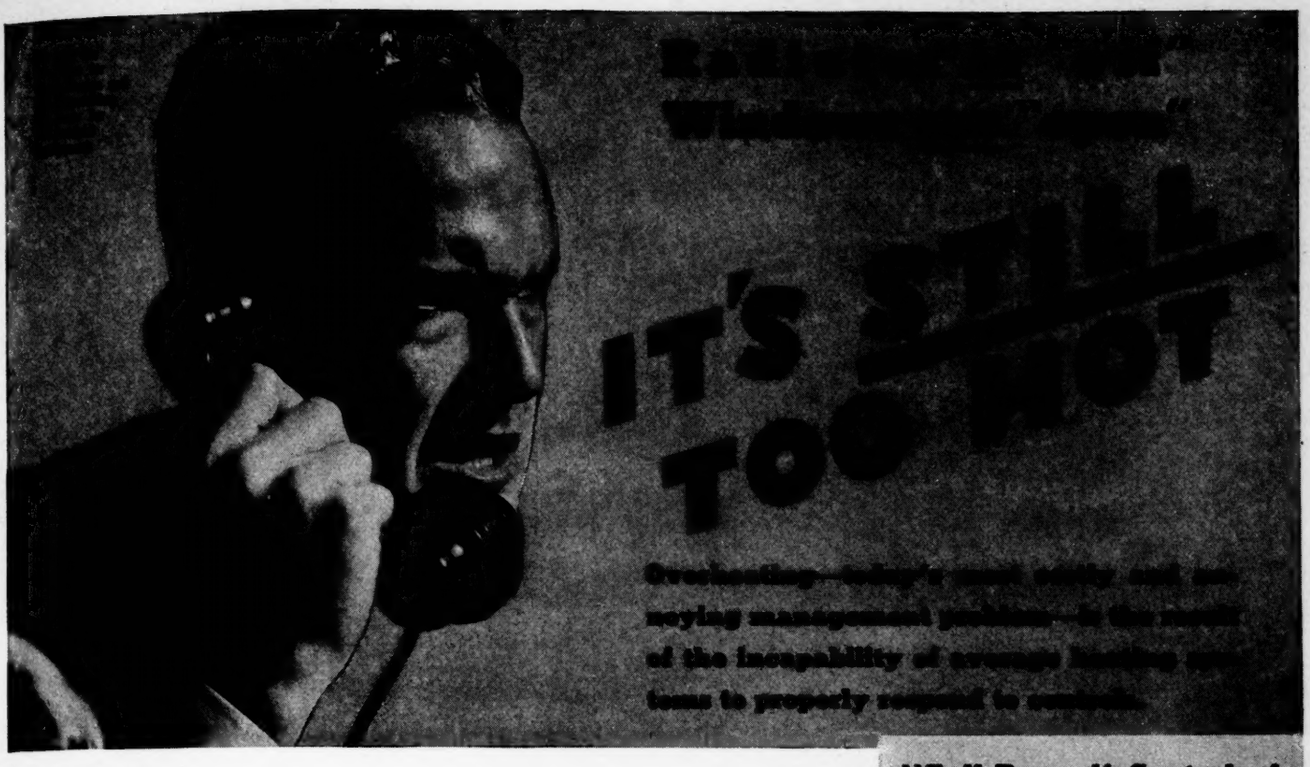
	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.	Peoria, Ill.	Philadelphia, Pa.
Degree-days for February, 1939.....	175	774	433	774	1258	1050	719
Degree-days, Sept. 1, '38 to Feb. 28, '39	884	3446	2129	2702	4330	4109	3251
Degree-days, Sept. 1, '37 to Feb. 28, '38	1110	3760	2607	2907	4780	4592	3600
Degree-days, Sept. 1 to Feb. 28, Normal	965	3869	2583	2986	4765	4673	3629

	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.	Reno, Nev.	Richmond, Va.
Degree-days for February, 1939.....	798	1125	679	888	767	900	548
Degree-days, Sept. 1, '38 to Feb. 28, '39	3536	4720	2862	3937	3570	3979	2630
Degree-days, Sept. 1, '37 to Feb. 28, '38	4005	4937	2722	4268	3846	3660	3045
Degree-days, Sept. 1 to Feb. 28, Normal	3947	4985	3174	4316	4082	4149	2935

	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.	Spokane, Wash.
Degree-days for February, 1939.....	1055	858	1081	385	907	683	1036
Degree-days, Sept. 1, '38 to Feb. 28, '39	4488	3169	4239	1637	4235	2925	4355
Degree-days, Sept. 1, '37 to Feb. 28, '38	4838	2662	3332	1502	4526	2774	4136
Degree-days, Sept. 1 to Feb. 28, Normal	4825	3652	4144	1770	4552	3308	4707

	Springfield, Ill.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for February, 1939.....	967	1031	1008	763	1147	634	973
Degree-days, Sept. 1, '38 to Feb. 28, '39	3689	4503	4181	3573	4965	3033	3333
Degree-days, Sept. 1, '37 to Feb. 28, '38	4171	4717	4661	3868	5193	3387	3585
Degree-days, Sept. 1 to Feb. 28, Normal	4191	4980	4467	3715	4966	3559	3773

Methods of applying the degree-day in connection with the operation of heating plants or for the prediction of fuel consumption of heating plants are described fully in the new enlarged edition of the DEGREE-DAY HANDBOOK, published by HEATING & VENTILATING, 148 Lafayette Street, New York, price $3. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.



● In mild weather but a small amount of heat is needed. Ordinary systems cannot supply so small an amount. Their mechanical limitations force them to answer the need for a small amount of heat with steam far hotter and in far greater volume than is needed. Thus they flood mains, risers and radiation with excess heat because there is no other choice except *no* heat.

Dunham Sub-atmospheric Steam Heating is the complete solution to overheating because it supplies—*as can no other system*—the exact amount of heat—no more—no less—to maintain the desired room temperature level.

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No other heating system is capable of this "full range" regulation of both steam temperature and steam volume. Since 1927 this system has established economy records in direct relation to its complete and automatic mastery of overheating. For technical data write to C. A. Dunham Co., 450 East Ohio St., Chicago.

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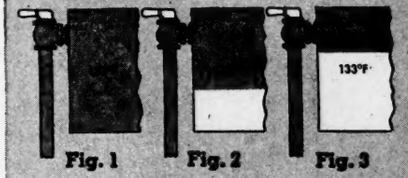

Fig. 1 Fig. 2 Fig. 3

Early spring morning with outside temperature approximately 40° finds a Dunham heated building at even 70° with radiation *filled* with 133° temperature steam (under a 25" vacuum). See Fig. 1.

As the day progresses, the sun lessens heat losses from the building and at noon the same 70° continues, with steam still 133° but with radiation about 2/3rds filled. See Fig. 2.

At 3 o'clock outside temperature has risen to around 60° and further lessened building heat losses. But 70° is still maintained in the building although now radiation is but 1/3rd filled with steam still of 133° temperature. See Fig. 3. This variation of steam volume is automatically regulated by thermostatic control.

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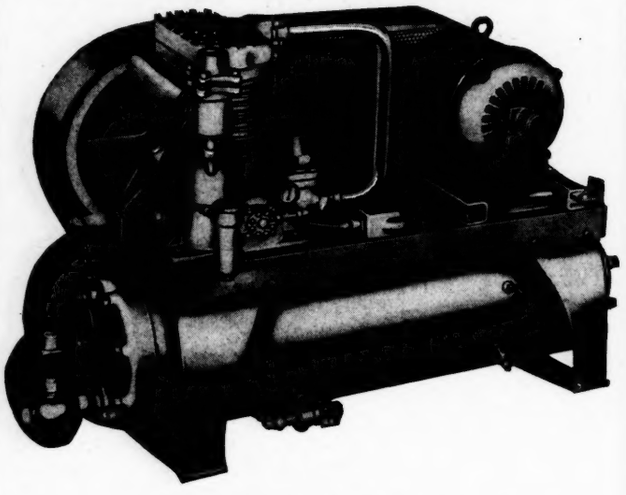
COMFORT CONDITIONING by DUNHAM

DUNHAM *Sub atmospheric Steam* HEATING



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MANUFACTURERS: Universal Cooler condensing units are made exclusively for you. They are not sold to distributors, dealers, contractors, or users. Universal Cooler's product and policy are suited to your needs. Make our factory *your* factory.

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Write today for data on our complete line of condensing units and compressors.

UNIVERSAL COOLER

DETROIT, MICHIGAN

In Canada: Universal Cooler Co. of Canada, Ltd. Brantford, Ontario

ADVERTISING AN AIR CONDITIONED STORE

(Concluded from page 27)

showed parts of the system in photographs, enlarged so that passersby might easily see them.

At the time the ill-fated Hindenburg flew over Boston on her last trip to America, photographers were stationed on the roofs of other high buildings in the vicinity, and when the Hindenburg was directly over the Filene store snapshots were made, with the big cooling tower and its sign in the immediate foreground, the Hindenburg looming large overhead. These were used in the firm's advertising and the news columns of local papers.

•

ANSWER TO PROBLEM ON PAGE 56

B. His income is always $50 more than A's. In the first year A gets $1000 and B gets $500+$550 or $1050. There will always be a difference of $50 in favor of B.

•

ANSWERS TO QUESTIONS ON PAGE 56

1. (4) is correct.
2. (3) is correct.
3. (1) is correct.
4. (3) is correct.
5. (5) is correct.

WITH THE MANUFACTURERS

The International Telephone and Telegraph Corp., New York, announces that its principal manufacturing subsidiary, *International Standard Electric Corporation*, has appointed *W. S. Kirkpatrick*, formerly distributor for Brunswick-Kroeschell Company and Carrier Corporation, to manage its sales of electric refrigeration and air conditioning products abroad, principally in the European market. Mr. Kirkpatrick will be supervisor of commercial refrigeration and air conditioning with headquarters in London. I. T. & T's manufacturing and selling operations are conducted throughout the world, outside of the United States and Canada, and it has made arrangements within the past several months to supply abroad, under International Standard Electric names and trademarks, products of Mills Novelty Co. and Baker Ice Machine Co.

National Radiator Corp., Johnstown, Pa., has consolidated its Richmond, Va., branch sales territory with the Washington branch. *W. E. Austin*, manager of the Richmond branch since 1919, has been appointed district manager with supervision of the Washington and Baltimore branches, with headquarters in Richmond. *Paul B. Holmes*, manager of the Washington branch for some years, continues as manager of the enlarged branch, and *N. H. Yates* continues as manager of the Baltimore branch.

The Nu-Way Corp., Rock Island, Ill., has elected *W. F. Klockau* president, *J. W. Manny* vice-president in charge of sales, and *O. K. Gipple* secretary-treasurer. Mr. Klockau for the past 13 years was chief engineer of Nu-Way, and O. K. Gipple was associated with the company for 12 years as assistant secretary and assistant treasurer.

Peerless Manufacturing Corp., Inc., Louisville, Ky., has named *R. B. Lyman* manager of its stoker division. Mr. Lyman was formerly sales manager of the stoker division of Butler Manufacturing Company.

Warren Webster & Co., Camden, N. J., has announced changes in its representation for the state of Texas. In northern Texas, *J. R. Dowdell*, 623 Santa Fe Building, Dallas, will represent the company in Dallas, Fort Worth, Waco, Amarillo, Abilene, Lubbock, Wichita Falls, and neighboring towns. Mr. Dowdell succeeds the late E. C. Waddington. In southwest Texas, *R. S. Ryden*, 407 Insurance Building, San Antonio, will represent the company in San Antonio, Austin, Laredo, San Angelo, Corpus Christi, and Brownsville. In southeast Texas, *R. B. Johnson*, Houston, continues to serve the cities of Houston, Beaumont, Galveston, and Port Arthur. *A. C. Greenawalt*, working under the direction of the Webster district representative at Denver, continues to serve El Paso and surrounding territory.

Young Regulator Co., Cleveland, Ohio, has appointed *Barton D. Wood, Inc.*, 2832 E. Grand Blvd., Detroit, in charge of its national sales.

NEW TRADE LITERATURE

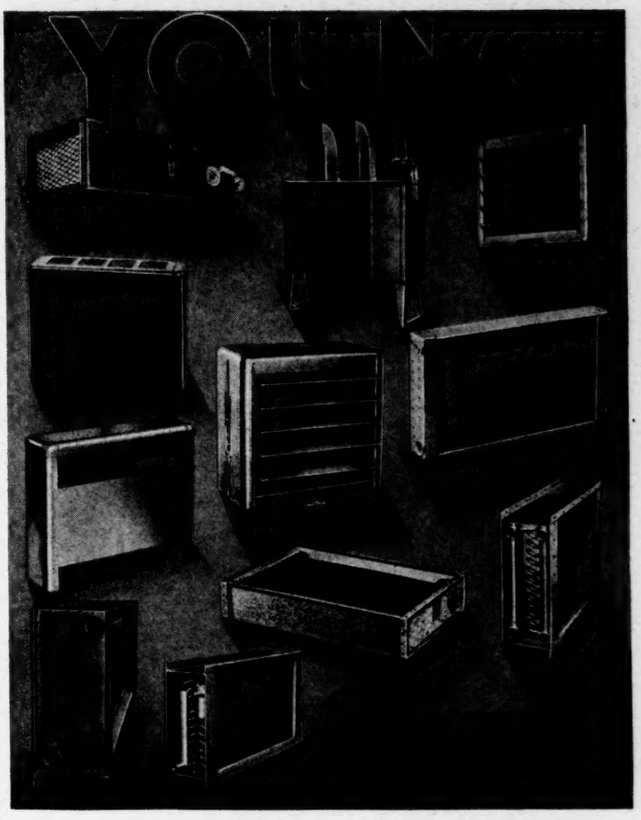
Air Conditioning. A standard-size, 16-page attractive bulletin describing the Williams Oil-O-Matic gas-fired year-round air conditioning system. This system provides cooling and dehumidification in summer, heating and humidification in winter, together with ventilation, air circulation and cleansing throughout the entire year. Refrigeration is obtained from an absorption unit. Bulletin describes the absorption unit, gives information on the cycle of operation, operating characteristics and construction features. Also included in the bulletin is information on the air distribution unit and controls. WILLIAMS OIL-O-MATIC HEATING CORP., BLOOMINGTON, ILL. 18

Attic Ventilation. A standard-size, 12-page catalog illustrating and describing Reed fans for attic, kitchen, and commercial ventilation. The attic fans of this line feature the Shut-O-Vent, which is an automatic shutter designed to close when the fan is off and to form a positive and insectproof seal between the house and attic. As soon as the fan is turned on the vanes open. REED UNIT-FANS, INC., NEW ORLEANS, LA. 19

Bearings. A standard-size, 72-page catalog, No. 390, giving information on the bronze bearing surface offered by the Johnson Bronze Company. Describes 800 stock sizes, machine finished ready for assembly, over 350 sizes of universal bronze cored and solid bars and over 230 sizes of Johnson electric motor service bearings, as well as lead-base and tin-base babbitt, cast bronze graphited bearings and plug type bearings. JOHNSON BRONZE CO., NEW CASTLE, PA. 20

Controls. A standard-size, four-page bulletin, No. 3960, illustrating and describing Paragon controls for air conditioning, stokers and oil burners. Includes description and specifications of time switches, stoker timers and relays. PARAGON ELECTRIC CO., CHICAGO, ILL. 21

Expansion Joints. A standard-size, four-page bulletin, X-39-5, describing the Type S stainless steel bellows, packless expansion joint. FOSTER WHEELER CORP., NEW YORK. 22



Whatever your heating or cooling problems, you will find a practical, economical solution in selecting a YOUNG product. Satisfactory past performance prompts many architects, heating contractors and engineers to specify YOUNG units for they know that YOUNG design incorporates every modern phase of heat transfer, and that the units are light in weight, easy to handle and install, compact and attractive in appearance.

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☐ 336 FH Unit Heaters ☐ 4536 Heat Transfer Surfaces.

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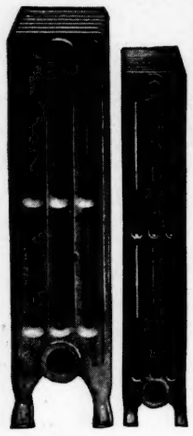
Here is an end comparative view of the old and the Burnham Slenderized Radiator.



Hank Sez—

There's A Way Ter *Belittle* The Big Things And To *Bebig* The Little Ones

Course, being as how we wuz among the first to put radiators on a reducing diet, it took us some time to convince you good scouts that the reducing hadn't hurt their health, but instead, bettered it.

When, however, you got ter seeing these Slenderized radiators a doin' a better job than had been done by the big huskies, you quit being offish, and becum alfired onish.

Instead of belittling, you started bebigging 'em. And you dun a mighty good job of it, and we want ter thank you plenty.

Like everything that has the most goodness, other folks started in trying to make small radiators what wuz just as good as our Slenderized.

Now when folks get ter claiming what they has, is as good as what we has, it's the same as admitting ours is the best yet. One thing sure, if ours wuz poorer than theirs, they wouldn't be saying theirs wuz as good as ours.

Which proves conclusively that our Slenderized must be better.

All of which you believed anyway, without all this chatter o' mine.

So just keep on buying Slenderized radiators and don't mind me.

Hank Hindle

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Motors. Two publications. The first a standard-size, eight-page booklet, No. 610, giving general information on NEMA standards and definitions for motors, and the second a four-page motor application bulletin, No. 515. The eight-page booklet on standards includes suggestions for the proper selection of motors, types of drives, information regarding service factors, rated loads, torques, and other important reference information for men who buy, specify, and maintain electric motors. Bulletin No. 515 lists 26 different types of motors and indicates the proper type of motor for about fifty standard applications. It also lists the starting, maximum, and full load torque characteristics, per cent of slip and other information. THE LOUIS ALLIS CO., MILWAUKEE, WIS. 23

Prefabricated Duct. Three standard-size, loose-leaf bulletins on Lamneck prefabricated duct and fittings for forced air heating and air conditioning systems. The first, which is catalog No. 39-AC, describes the three systems of prefabricated duct which are available, illustrates the various fittings, and gives information on dimensions and list prices. The second publication is an engineering guide giving instructions for designing air distribution systems when prefabricated duct and fittings are used. The third bulletin is a manual of installation which shows how the Lamneck prefabricated duct system should be installed. LAMNECK PRODUCTS, INC., COLUMBUS, OHIO. 24

Refrigeration. A card containing six detector wicks which are used to discover the source of an ammonia leak. This card of six wicks is offered free to users of ammonia. PENNSYLVANIA SALT MANUFACTURING CO., PHILADELPHIA, PA. 25

Unit Heaters. A standard-size, eight-page catalog, W-N 105, describing the Webster-Nesbitt Series F unit heaters designed for use in heating lobbies, offices, showrooms, and similar places where high capacity, neat appearance, and quietness are desirable. Gives information on construction features, capacities, control diagrams, dimensions and specifications. JOHN J. NESBITT, INC., HOLMESBURG, PHILADELPHIA. 26

Valves. A standard-size, 27-page booklet entitled Controlled Valves. Describes two generally used types of air-operated controlled valves, the quick-opening type for open and shut control and the Stabilflo type for throttling control. Detailed information on these valves is contained in the catalog. For engineers who frequently compute valve sizes, this company is also offering a pocket-size slide rule, scaled for liquid, gas, and steam calculations, direct-reading in valve sizes. This 6-in. valve rule in a leather case will be sent free to engineers who request it on their business letterhead. THE FOXBORO CO., FOXBORO, MASS. 27

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COMING EVENTS

APRIL 11-13, 1939. Fourth Iowa Heating & Air Conditioning Conference, Iowa State College, Ames, Iowa.

APRIL 13-14, 1939. Third Food Preservation Conference, University of Texas, Austin, Tex. Chairman, Prof. Byron Short, University of Texas.

APRIL 14-15, 1939. Third Annual Conference on Air Conditioning, University of Texas, Austin, Tex. Chairman, Prof. H. E. Degler, University of Texas.

APRIL 28-29, 1939. Second Annual Anthracite Conference, Packard Memorial Hall, Lehigh University, Bethlehem, Pa. Chairman, Committee on Arrangements, Prof. Howard Eckfeldt, Lehigh University.

MAY 19-20, 1939. Second Coal Conference, Washington University, St. Louis, Mo.

MAY 22-23, 1939. 26th Spring Meeting, American Society of Refrigerating Engineers, Hotel Hershey, Hershey, Pa. ASRE Headquarters, 37 West 39th St., New York.

MAY 23-25, 1939. Fifth Short Course in Coal Utilization, University of Illinois, Urbana, Ill. Chairman of Program Committee, Prof. H. P. Nicholson, University of Illinois.

MAY 24-26, 1939. Annual Convention, Association of Gas Appliance and Equipment Manufacturers, Hotel Roosevelt, New York. Association Headquarters, 60 East 42nd St., New York.

MAY 31-JUNE 2, 1939. 50th Annual Convention, Heating, Piping and Air Conditioning Contractors National Association, Drake Hotel, Chicago, Ill. Association headquarters, Room 1401, 1250 Sixth Ave., New York.

JUNE 1-2, 1939. Annual Convention, Stoker Manufacturers Association, French Lick Springs, Ind. SMA Headquarters, 307 N. Michigan Ave., Chicago.

JUNE 5-7, 1939. Mid-Year Meeting, National Warm Air Heating and Air Conditioning Association, Stevens Hotel, Chicago. NWAH & AC headquarters, 5 E. Long St., Columbus, Ohio.

JUNE 5-8, 1939. National Association of Master Plumbers Convention, Minneapolis, Minn. NAMP headquarters, 917 15th St., NW., Washington, D. C.

JUNE 13-16, 1939. 33rd Annual Convention, Smoke Prevention Association. Hotel Schroeder, Milwaukee, Wis. An Exhibit of Fuel-Burning Equipment will be a feature. SPA headquarters, City Hall Sq. Bldg., Chicago.

JUNE 27-30, 1939. 30th Annual Convention and Equipment Exhibit, National District Heating Association, Hotel Pennsylvania, New York. NDHA headquarters, 1317 Spruce St., Philadelphia, Pa.

JULY 4-6, 1939. 45th Semi-Annual Meeting, American Society of Heating and Ventilating Engineers, Grand Hotel, Mackinac Island, Mich. ASHVE headquarters, 51 Madison Ave., New York.

SEPTEMBER 20-22, 1939. Annual Conference, National Industrial Advertisers Association, Hotel New Yorker, New York. Headquarters NIAA, 100 E. Ohio St., Chicago.

OCTOBER 4-6, 1939. Exposition of Building, Industry and Services, Hotel Statler, Detroit, Mich. Sponsored by the Mortgage Bankers Association of America. George H. Patterson, Secretary-Treasurer, 111 West Washington St., Chicago, Ill.

OCTOBER 17-20, 1939. 68th Annual Meeting, American Public Health Association, William Penn Hotel, Pittsburgh, Pa. APHA headquarters, 50 West 50th St., New York.

JANUARY 22-26, 1940. 46th Annual Meeting, American Society of Heating and Ventilating Engineers, Cleveland, Ohio. To be held in conjunction with the 6th International Heating and Ventilating Exposition at the Cleveland Public Hall.

JANUARY 23-25, 1940. 35th Annual Meeting, American Society of Refrigerating Engineers, Hotel Cleveland, Cleveland, Ohio.

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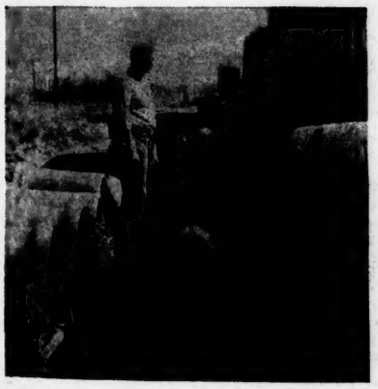

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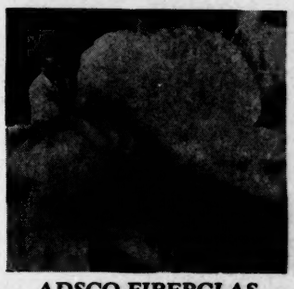

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